ON-SITE SEWAGE DISPOSAL SYSTEMS

TECHNICAL GUIDELINES

NOVA SCOTIA DEPARTMENT OF HEALTH

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CONTENTS

		PAGE
1	Introduction	
1.1	Purpose and use	1-01
1.2	Background	1-01
1.3	Components of on-site systems	1-01
1.4	Before you buy land	1-03
2	Site Evaluation	
2.1	Lot sizes	2-01
2.2	Topography	2-01
2.3	Soil conditions	2-03
2.4	Other considerations	2-08
3	System Design	
3.0	General considerations	3-01
3.1	Septic tanks	3-04
3.2	Area disposal fields	3-06
3.3	Multiple trench disposal fields	3-08
3.4	Contour trench disposal fields	3-10
3.5	Imported fill contour and mound disposal fields	3-15
3.6	Leaching Chambers	3-24
3.6	Interceptor drains	3-25
3.7	Pumps,siphons and pipework	3-25
4	Construction and Installation	
4.0	General	4-01
4.1	Septic tanks	4-01
4.2	Soil construction damage	4-02
4.3	Conventional Disposal Fields	4-03
4.4	Contour and Imported Fill Contour Disposal Systems	4-04
4.5	Mound Disposal Systems	4-05
4.6	Leaching Chambers	4-06
4.7	Interceptor drains	4-06
5	Other Systems	
5.1	Grey water disposal	5-01
5.2	Privy and non water carried systems	5-01
6	Maintainance Requirements	
6.1	General maintainance	6-01
6.2	Rehabilitation	6-02
7	General	
7.1	Large on-site systems	7-01
7.2	Wastewater Management Districts	7-01

APPENDICES

A Referances

B Sanitary Privies

C Permeameter Test

D Deep Draught Siphon

E Measurement of Permeability

F Sloping Sand Filter

G Selection of Disposal Field - Flow Chart

H Minor Variations

I Location of Offices

1.0 INTRODUCTION

1.1 Purpose of the Guidelines & How to Use this Book

The Guidelines are intended to be a supplement to the Nova Scotia Regulations Respecting On-Site Sewage Disposal Systems 1985. They are intended to be used as an educational and technical manual by the general public, installers of systems, and others for explaining the principles and concepts of on-site sewage disposal. If, after reading the book, you have unanswered questions contact your local Department of Health.

1.2 Background of On-Site Sewage Disposal

The term, On-Site Sewage Disposal, as used in both the Regulations and Guidelines refers to disposal of all domestic sewage, produced by a home or institution, into the soil and groundwater environment.

There has always been sewage disposal of some type in rural and urban areas. Many of the methods used in years gone by are not acceptable by today's standards, particularly when the serious health consequences of unsatisfactory disposal are well known. Rural areas of North America did not experience serious problems with domestic sewage disposal when housing density was low and water was either carried or hand pumped to the house. The advent of electricity and the spread of residential housing into rural areas changed that. With inside plumping facilities, including flush toilets, and lot sizes measuring in hundreds of square feet rather than hundreds of acres, the aesthetic and health problems associated with domestic sewage discharge to ground surface became all too apparent.

The Health Act of 1962 gave municipal Boards of Health in the province the authority to regulate the disposal of sewage within their jurisdiction. The first provincial regulations (1975) were largely based on practices in other areas of North America. These regulations were amended in 1978 and 1980 to allow for changes due to experience and advances in technology.

Until very recently, on-site disposal has not been taken as seriously or given the attention by academic or professional groups that has been given urban sewage disposal. The 1985 revisions have incorporated some of the most recent concepts in on-site disposal in an attempt to have the installation of systems that are reasonably priced, yet will provide long term acceptable performance when designed, installed and maintained properly.

1.3 Components of On-Site Disposal Systems

The on-site disposal system referred to in these regulations includes the building sewer after it leaves the building, the

septic tank and the soil absorption system (see fig. 1.3.1). The building sewer is simply a water tight pipe that carries the sewage from the building to the septic tank.

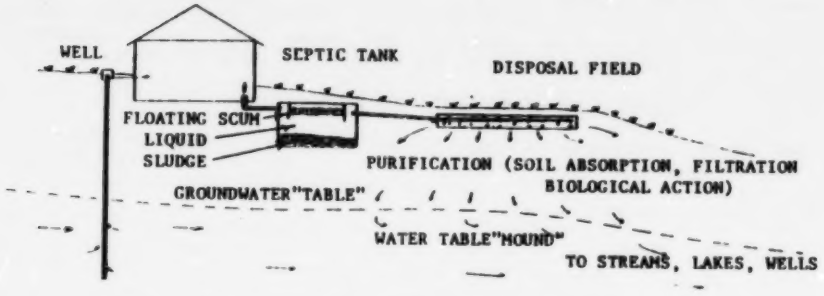


FIG. 1.3.1 SEPTIC TANK SOIL ABSORPTION SYSTEM

The septic tank is essentially a settling tank where the raw wastewater is retained long enough for the settleable solids, fats and greases to be removed. This prevents the interstices or voids in the soil beneath the absorption system from becoming clogged. For satisfactory performance, wastewater should take two days to pass from the inlet to the outlet of the tank (Tank Retention Time). For routine maintenance requirements on the tank see section 6.1.

The size and layout of a soil absorption system (disposal field) varies according to site conditions and anticipated loads. In fig.1.3.2 the basic components of any system are shown. The perforated pipe and gravel distribute the tank effluent over the disposal area. The gravel or crushed rock provides storage for peak effluent flows, a large infiltration surface between the effluent and underlying soil or sand, provides a bed for the pipe and protection over it. Placing at least three inches of sand under the gravel on sites with poor soil conditions may improve performance of the disposal system. The clogging mat will be formed in the sand thus reducing the clogging and sealing of the soil interface. On sites where the soil will not absorb the effluent at an acceptable rate a built-up disposal bed may be required and therefore, in these cases soil with an acceptable percolation rate is placed on the site beneath the disposal

field. There are some lots where the construction of an interceptor drainage system will divert the flow of ground and surface water away from the disposal area, thus making the lot suitable for an on-site disposal system.

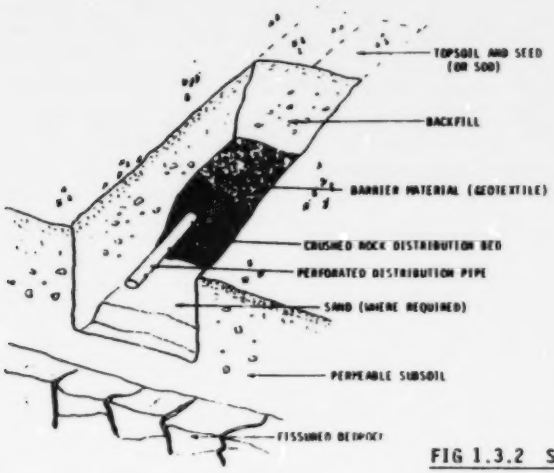


FIG 1.3.2 SOIL ABSORPTION SYSTEM

Additional information on the components of a system can be found in sections 3 & 4 concerning design and construction.

1.4 Before You Buy a Building Lot, Subdivide Land or Build a Home

Unfortunately, in some areas people are still able to buy a lot, spend money on a proposed subdivision or even start to build a home before they realize there are a number of pertinent regulations that may be applicable.

The lot sizes in the 1985 on-site sewage disposal regulations are primarily intended to apply to individual lots with on-site water and sewage disposal facilities that are not in areas of high density development. Where any proposed subdivision or amendment to a plan of subdivision requires the approval of a Development Officer, and is not serviced by a sewage collection system, the Regulations Respecting Subidivision of Land to be Serviced by On-Site Sewage Disposal Systems also apply.

Before you buy a lot which does not have a municipal sewer system or start to build on such a lot, be sure you have a valid Permit For Installation of an On-Site Sewage Disposal System. This permit is issued by the Municipal Board of Health. Applications

for the permit can be obtained from and made to the municipal office. Once application is made personnel from the Department of Health will make arrangements to assess the lot and present the results of the assessment to the Board of Health. The applicant may engage a consultant who is a qualified person (see definitions in the Regulations) should he or she wish to submit an independant assessment to the Board. If the application is not recommended the applicant may request a hearing with the Board if he feels strict enforcement of the Regulations would be unjust.

Other regulations, not under the Health Act, will also apply if you are buying a lot, subdividing or building. To be sure all have been complied with, you should consult the development office, building inspector, or municipal clerk.

2.0 SITE EVALUATION

2.1 Lot Size & Dimension

The minimum lot sizes given in the Regulations pertain to individual lots, i.e., possibly limited ribbon development, isolated lots, etc. These lot sizes depend on the natural soil conditions on the lot and are:

	Minimum Lot Size
Category I	20,000 square feet, 100 foot width
Category II	50,000 square feet, 175 foot width
Category III	100,000 square feet, 250 foot width

Larger lot sizes may be required where there is existing or proposed high density development with on-site water supplies and sewage disposal. Minimum lot sizes for lots in subdivision are given in the Regulations Respecting Subdivision of Land to be Serviced by On-Site Sewage Disposal Systems. In some cases these minimum lot size requirements may be significantly larger than those required in the "On-Site Regulations". The lot width for the purpose of these regulations is the least dimension of the lot measured at the centre of the area where the disposal field is or will be located. (See fig.2.1.1)

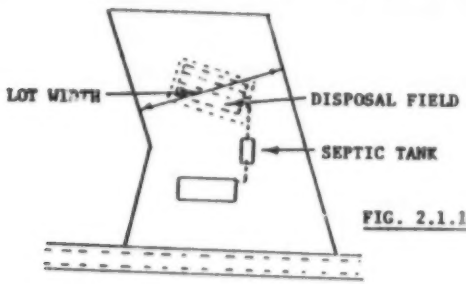


FIG. 2.1.1. BUILDING LOT WIDTH

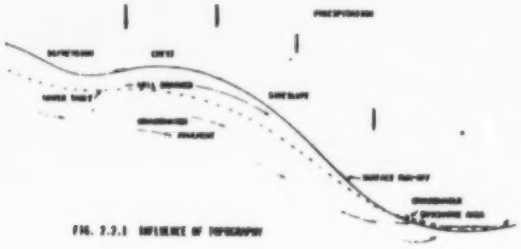
If after a complete site evaluation of a lot the Department feels the lot size is not adequate, additional land may have to be obtained before lot approval can be recommended.

2.2 Lot Topography

The surface features important in a site evaluation include: slopes, rock outcrops, watercourses, traffic areas and type of natural vegetation.

There are exceptions, but the typical soil in Nova Scotia is a glacial till with increasing compaction with depth. The top few feet of soil are typically more permeable than subsequent depths due to root penetration, weathering, etc. As a result, in most

cases water, either from rainfall or from an on-site sewage disposal system, tends to flow down a slope through this permeable layer until such time as it is able to penetrate the deeper soil, evaporate, break to the surface, or enter a water-course. See Fig. 2.2.1



Steep slopes in combination with poor soil conditions make the design, installation and operation of an acceptable on-site disposal system difficult or even unacceptable. As a rough guideline, even with reasonably good soil, the following maximum slopes apply:

Type of System	Maximum Slope
Mound	10% (6 deg.)
Area or Trench	15% (9 deg.)
Contour	30% (17 deg.)

The location of a disposal system on a slope is important. Groundwater moving down the slope too near the surface can be contaminated by intercepting the effluent before the latter is adequately treated. Run-off from up-slope areas may flood the bed. Thus poorly drained soils,shallow soils,areas of high groundwater level or areas receiving large volumes of run-off should be avoided. (see fig.2.2.2)

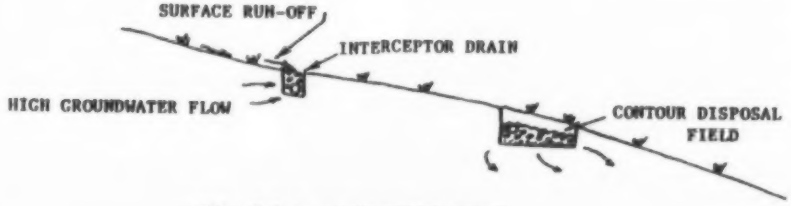


FIG. 2.2.2. INTERCEPTOR DRAIN

Assuming other parameters constant the best location for a system on a slope is at or near the crest. Areas further down the slope may require upslope interceptor trenches to catch and divert surface run-off and/or groundwater away from the disposal field.

Distance from a disposal system to sharp changes in grade is also an important consideration on a lot. Effluent from the system may break out at the surface if it has not already entered the subsoil. We, therefore, need adequate separation distances from breaks in slope such as those listed below:

Category I	25 feet
Category II	35 feet
Category III	50 feet

The overall slope on the lot also can affect the foundation elevation, whether or not pumping is required, plus the type and design of disposal system. (see Appendix G) For example, on a lot with little slope, plumbing could not be installed in a full basement without pumping up to the disposal system, which is no more than 2 feet below grade. However, on a sloping lot pumping may not be necessary. A long narrow system installed parallel to the contour is preferred on a sloping lot. It not only blends into existing grades, but spreads the effluent across a longer slope interface and as a result is more likely to function satisfactorily. (See section 3.4)

Rock outcrops on a lot indicate limited soil cover over bedrock. If untreated effluent enters fractures in bedrock, it can contaminate wells hundreds of feet away. The bottom of the pipe, in any disposal system, should not be less than 3 feet above bedrock.

In order to prevent contamination of watercourses, the following distances are recommended between any part of a disposal system and a watercourse:

Category I	100 feet
Category II or III	150 feet

Vehicular traffic should not be allowed to travel over a disposal bed. Even if pipes were installed such that they would not be crushed, compaction could damage the disposal field.

2.3 SOIL CONDITIONS

Soil conditions are the most important parameter in site evaluation and system design. An estimate must be made of the ability of the soil to accept the effluent from the disposal system. This is not an easy task. Installation of the system itself may change absorption capacity, and clogging of the soil interface which may take place at some future date cannot be measured now (see Fig.2.3.1).

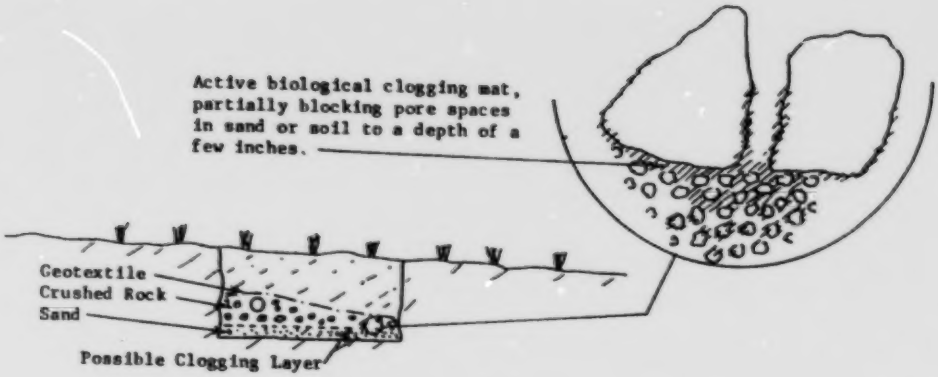

Active biological clogging mat, partially blocking pore spaces in sand or soil to a depth of a few inches.
Geotextile
Crushed Rock
Sand
Possible Clogging Layer

FIG. 2.3.1. Soil Interface Clogging Layer

Assessment of the ability of the soil to accept the effluent is a judgement decision based on soil properties and past experience, combined with the results of a test such as the percolation test which gives some indication of permeability.

Some soil properties that are useful in assessing the soil suitability include: a) texture b) structure c) depth d) color e) density.

Soil texture is the relative amount of gravel, sand, silt and clay content. Some soil classes and ways of identifying them are given in Table 2.3.1. When water passes through soil it goes through the voids between soil particles and not the solid particles themselves. In most cases this means that the larger the voids or pore spaces and the more pore spaces, the faster the water will pass through the soil. If you compare a sand to a clay you can appreciate that the sand has many large voids between relatively large particles whereas the voids between the small clay particles are so small that little, if any, water can pass through. A sand has a high permeability, a clay a very low permeability.

As effluent from a disposal field passes through a silty soil, particulate matter are physically filtered out in a relatively short distance. Most bacteria, viruses or other potentially disease causing organisms (pathogens) are not able to pass through long distances of unsaturated soil. They may be retained within the first few feet of soil until the numbers are greatly reduced in the hostile environment. In saturated soils the organisms may travel greater distances.

If effluent entered a heavy gravel with little or no fine material (silt and clay particles), it would pass through the

TABLE 2.3.1 - TEXTURAL PROPERTIES OF MINERAL SOILS

Soil Class	Feeling and Appearance	
	Dry Soil	Moist Soil
Sandy gravel	Loose stones and single grains which feel gritty. Squeezed in the hand, the soil mass falls apart when the pressure is released.	Squeezed in the hand, it forms a cast which crumbles when touched. Does not form a ribbon between thumb and forefinger.
Silty sand	Aggregates easily crushed; very faint velvety feeling initially but with continued rubbing the gritty feeling of sand soon dominates.	Forms a cast which bears careful handling without breaking. Does not form a ribbon between the thumb and forefinger.
Sandy silt	Aggregates are crushed under moderate pressure; clods can be quite firm. When pulverized, soil has velvety feel that becomes gritty with continued rubbing. Casts bear careful handling.	Cast can be handled quite freely without breaking. Very slight tendency to ribbon between the thumb and forefinger. Rubbed surface is rough.
clayey silt	Aggregates are firm but may be crushed under moderate pressure. Clods are firm to hard. Smooth, flour-like feel dominates when soil is pulverized.	Cast can be freely handled without breaking. Slight tendency to ribbon betweeen thumb and forefinger. Rubbed surface has a broken or rippled appearance.
Silty clay	Very firm aggregates and hard clods that strongly resist crushing by hand. When pulverized, the soil takes on a somewhat gritty feeling due to the harshness of the very small aggregates which persists.	Cast can bear much handling without breaking. Pinched between the thumb and forefinger, it forms a ribbon whose surface tends to feel slightly gritty when dampened and rubbed. Soil is plastic, sticky and puddles easily.
Clay	Aggregates are hard; clods are extremely hard and strongly resist crushing by hand. When pulverized, it has a grit-like texture due to the harshness of numerous very small aggregates which persist.	Casts can bear considerable handling without breaking. Forms a flexible ribbon between thumb and forefinger and retains its plasticity when elongated. Rubbed surface has a very smooth, satin feeling. Sticky when wet and easily puddled.

voids unfiltered and so quickly that pathogens could travel hundreds of feet. The ideal soil on a lot would be several feet of silty sand. Unfortunately, this is not a common soil condition in Nova Scotia.

In some soils individual particles tend to group together into blocks or units called peds. If these peds have a characteristic shape for a soil, it is said to have structure. The space between these peds and how they are aligned can influence the ability of water to move within the soil and may indeed affect a percolation test, giving a false impression of high permeability. For the purpose of these guidelines, the only further mention of structure will be in a following section concerning construction damage.

The depth of permeable soil may determine lot dimensions and system design. Other site characteristics must also be considered in combination with soil depth. For example, a system installed in a very shallow soil on a lot with a steep slope is more likely to malfunction than similar soil conditions on a lot with only a moderate slope. If the depth of suitable soil over permanent water table or creviced bedrock is not enough to adequately treat the effluent then it is possible that contaminants could enter wells in the area. The regulations require a minimum separation distance between the bottom of the distribution pipe and highly permeable soil or fissured bedrock, of 3 feet. In some cases, if this depth of soil is not naturally present on the lot, a mound system can be constructed (see Section 3.5).

Some types of vegetation, such as alders and rushes, tend to grow in certain areas. These may be an indication of saturated soils.

Soil color is a property that is useful in soil assessment. Color and color patterns provide clues toward estimating the ability of a soil to absorb water. There are complex color charts for soil color determination which are beyond the scope of these guidelines. Much of our soil color is due to the presence of iron. When there is no air in the soil, iron exists in a state that is greyish. When air is abundant in the soil, the soil is well drained, iron is in a state which is yellowish or reddish. If over a long period of time a soil has been alternately wet and dry, it may show defined spots or blotches of different color, possibly with a grey or dark predominant color, this is known as mottling. This would indicate that at times (usually spring and fall) this soil is saturated,i.e., poorly drained. On the other hand a well drained soil would be a relatively bright color (often reddish yellow) and be free of mottling to at least 4 foot depth.

Soil density or degree of compaction can influence the ability of soils to accept water. Two soils with similar textures can have different permeabilities if their densities are different. The

denser a soil becomes, the smaller the pore spaces and the slower the rate of water movement. The natural soil conditions in Nova Scotia are mainly the result of the last glacier age. In many areas the soil is comprised of glacial till, an assortment of material ranging from rocks to clay, that was deposited beneath the ice and subject to great compactive forces. Other areas have soils consisting of sediments deposited by melt water streams that tend to be less compact. Although the top few feet of till tends to have been loosened by weathering and root action, it is common to find increasing compaction with depth and extremely dense and impervious till below a couple of feet.

Soil can also be compacted by actions such as running heavy machinery over it. For a further discussion of man-made compaction see section 4.2 dealing with construction.

The soil properties mentioned,i.e., texture, structure, depth, color and density can be best described for a site by digging an observation pit. For safety, the pit should be no more than four feet deep, with sloping sides and an entrance ramp for easy access and escape in the event of a soil slide. If the pit is dug by backhoe and verification of subsoil conditions is required, the pit may be taken to a greater depth, but inspection should be carried out from the surface with the aid of samples of soil recovered by the machine bucket. A soil profile can then be recorded based on the variation in soil characteristics with depth. (see Fig.2.3.2)

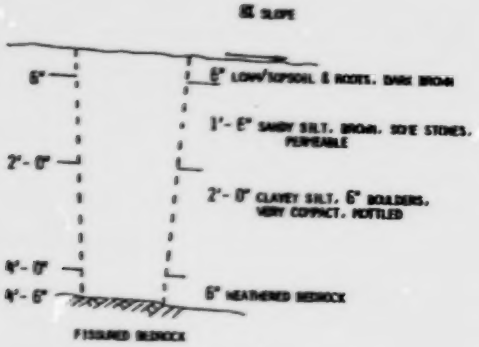


FIG. 2.3.2 EXAMPLE OF SOIL PROFILE

The percolation test, if done by a standard procedure, in most cases gives a rough estimate of the ability of one soil to absorb water as compared to another. It has a number of limitations, but can be useful if considered as part of the total site investigation. Observation pits should be used in conjunction with percolation test results particularly if percolation tests are not consistent or results do not seem to be what was expected. The exact procedure for conducting a percolation test is included in the Regulations and instructions for preparing holes are included on the back of the Permit application. Stated very briefly the general procedure is -

a) The applicant digs 4 holes, 30 inches deep, approximately 12 inches in diameter and a minimum of 25 feet apart, within the area where he proposes to put his sewage disposal bed. The applicant provides approximately 45 gallons of water at the site.

b) Upon receipt of the completed application the public health inspector visits the lot to do a site evaluation. Water is placed in the holes to a specified level and the water level marked. The rate of drop of water level is noted and the procedure repeated until a constant rate has been reached. The time in minutes required for the water level to drop 1 inch is the percolation rate.

2.4 Other Site Considerations

Other items that must be given consideration include well locations and watercourse locations. Different site conditions require different separation distances between the disposal system and a well. These separation distances are required to provide a reasonable assurance that the water quality of the well will not be adversely affected by the system. Separation distances shall be determined by the qualified person who assesses the lot, but in no case shall they be less than the separation distances specified in the regulations. Suggested minimum clearances are shown in table 2.4.1.

TABLE 2.4.1 MINIMUM CLEARANCES FROM DISPOSAL SYSTEM

	Disposal Field	Septic Tank
Drilled well (Min. 20 ft. casing)	50'	50'
Dug well	100'	100'
Foundation drain	20'	5'
Highway ditch (downslope) (1)	30'	30'
Downslope boundary		
category I lot	30'	30'
category II lot	75'	75'
category III lot	100'	100'

(1) Not being part of a stream or watercourse

In no case should a well be directly down slope of a system unless there is several hundred feet separation distance, and no chance of well contamination. Where lots are located one above another on a slope this requires some long range planning so that well locations and disposal system locations are compatible.

The minimum clearances from a disposal system to a watercourse is 100 feet. Here a watercourse includes any natural body of water except drains or ditches that flow intermittently, in which case a minimum distance of 50 feet is required.

3. Design of Disposal Systems.

3.0 General considerations.

The principles of design of subsurface soil absorption disposal systems for installation in Nova Scotia have been modified to take account of new concepts in effluent treatment. Not only must we consider the filtration of the effluent as it passes into the soil, which is governed mainly by the area of the bed, but we must also examine how the effluent will travel in the subsoil away from the bed. In the majority of cases, due to high groundwater table, bedrock or impermeable material near the surface, the treated effluent must move away laterally, rather than vertically downwards, but it is still moved by gravity in the dirsction of the water table slope.

After several months of operation a disposal field will develop a layer of solids consisting largely of debris and microbiological organisms that digest the organic materials in the septic tank effluent. This clogging layer has a very low permeability, much lower than the surrounding soil and, at periods of high flow, effluent will pond within the distribution bed (i.e. the gravel layer) in order to generate enough pressure to force the effluent through the clogging layer. The hydraulic resistance of this layer will normally build up to a certain value and remain at this without further increase. To a certain extent the value of this resistance is dependant upon the surrounding soil type, finer soils generating higher resistance. However, if a layer of clean sand (3 in.deep) is placed beneath the gravel, the clogging layer will develop on the sand and the total final resistance will be reduced. With the sand layer, a loading rate of 1.0 gal./day per 1.5 sq.ft.of distribution bed area will prevent excessive build up of hydraulic resistance. Without the sand layer the following loading rates are the maximum permissible (Table 3.0.1).However, it should be noted that these reduced rates are not permitted for area and multiple trench disposal fields, due to a number of other overriding factors.

Table 3.0.1 Soil Loading Rates

Soil Type	Max. Loading Rate (sq.ft./gal./day)
Sandy gravel	1.5 *
Silty sand	1.5
sandy silt	2.0
Clayey silt	3.0
Silty clay	5.0

* Sandy gravel may require less permeable fill beneath the distribution bed.

In designing the type and layout of the disposal bed the hydraulic conductivity of the soils beneath the bed must be

considered. Estimates of effluent flow may generally be made using D'arcy's law, which considers the velocity of flow in relation to the hydraulic gradient and the permeability of the soil. In-situ measurement of permeability is possible with specialised apparatus, but it is not normally carried out except for large systems (See Appendix E). A laboratory sieve analysis can be interpreted to indicate permeability but may not take into account pore spaces created by weathering and root action and other factors such as density and soil structure.

The next best indicators of permeability are a) soil classification from direct examination of the soils in a test pit and/or b) soil grain size analysis. A percolation test as described in section 2.3 is not a totally reliable means of estimating permeability but may be considered in conjunction with test pit data and/or knowledge of local soils. The results of a percolation test are dependant more upon the original soil moisture content than upon inherent permeability. The percolation rate will vary greatly with depth to water table, size of hole and recent weather conditions. Table 3.0.2 lists common soil types with a guide to permeability and range of percolation rate.

Table 3.0.2 Guide to Soil Type and Permeability

Soil type	Percolation range * (min.per in.)		Permeability ($m/sec. \times 10^{-6}$)		Effluent velocity
	saturated	dry	range	mean	on 10% slope
Sandy gravel	5	1	20 - 80	50	17 in./day
Silty sand	20	3	8 - 20	15	5 "
Sandy silt	40	10	2 - 8	5	1.7 "
Clayey silt	60+	20	0.8 - 2	1.5	0.5 "
Silty clay	100+	30	0.2 - 0.8	0.5	0.15"

* dependant upon weather, water table, etc.

Having established soil type or permeability, the depth of soil and general slope of the terrain, the required subsurface disposal system may be selected. Table 3.0.3 lists the alternatives available for various combinations of individual lot conditions and may be used in the selection of the most appropriate option available for that particular site. It must be stressed, however, that design for multiple unit dwellings, institutions and commercial establishments must be made from first principles discussed above.

Having selected the most appropriate design option, further details may be referenced in the following sections. (see Contents and Index)

TABLE 3.0.3 DISPOSAL SYSTEM SELECTION - AVAILABLE OPTIONS

Effective Soil Depth	Ground Slope %	Normal Lot Cat.	Sandy Gravel	Silty Sand	Sandy Silt	Clayey Silt **	Silty Clay **
2 feet or more	11-30		AT,C1*	AT,C1	AT,C1,2	AT,C1,2	C1,2
	6-10	I	AT,C1*	AT,C1	AT,C1,2	AT,C1,2	C2,3
	0-5		AT,C1*	AT,C1	AT,C1,2	AT,C1,2	C2,3,M
1 foot to 2 feet	11-30		C1-3*	C1-3	C1-3	C1-3	C2,3
	6-10	II	C1-3*	C1-3	C1-3	C1-3	C2,3
	0-5		C1-3,M*	C1-3,M	C1-3,M	C2,3,M	C3,M
1 foot or less	11-30		C2,3*	C2,3	C2,3	C2,3	C2,3
	6-10	III	C2,3*	C2,3	C2,3	C2,3	C2,3
	0-5		C2,3,M*	C2,3,M	C2,3,M	C2,3,M	C3,M

KEY

AT	Area field or multiple trench system
C1	Contour system type C1
C2	Imported fill contour system type C2
C3	Imported fill contour system type C3
M	Imported fill mound system

NOTES

* Where, due to fractured bedrock or highly pervious subsoils, there is danger that a "short circuit" will allow bacteria from the disposal field to enter the well system, then a disposal system type C3 or M is to be used.

** Usually Category II or III conditions.

SEE ALSO -:

Flow Chart for selection of Appropriate Disposal Field. - Appendix B.

3.1 SEPTIC TANKS

3.1.1 Design.

The size of septic tank required will be shown on your permit. The tank capacity is chosen in accordance with provincial regulations (see following table). Larger tanks may be installed if you wish to increase the life of your system.
Garbage grinders are not encouraged but where used the tank capacity should be increased by 20% to provide adequate additional sludge storage space.

Table 3.1.1 Septic Tank Capacity for Dwellings

Number of Bedrooms	Liquid Capacity (Imp. Gals.)	
3 (or less)	600	(1)
	1000	(2)
4	720	(1)
	1000	(2)
5	900	(1)
	1000	(2)

Notes (1) Minimum Size
(2) Minimum Size for Categories II & III

Tanks should be designed to allow sewage to enter at one end, have a slow uniform horizontal flow through the tank, and discharge the liquid effluent at the other end with the least possible disturbance of the tank contents. The tank should never be under-sized; the larger the tank the more efficiently it will operate, and the less frequently it will require cleaning.

Standard manufactured septic tanks, constructed of precast reinforced concrete, glass-reinforced plastic (fibreglass) or polyethylene are available in a range of sizes covering the regulations and it is probably to the advantage of the homeowner to make use of these. Manufacturers are licensed to produce tanks after submitting details of their design for approval. The purchaser should make sure that his tank has been produced by a licensed manufacturer. Recommended dimensions are shown in table 3.1.2

If the owner so desires a septic tank may be constructed of poured -in-place reinforced concrete., In this case the Public Health Inspector or Engineer will require details of the design (dimensions, reinforcement, concrete specification) at the time of submitting the application. Typical plans may be supplied by the department

The Province permits single compartment tanks complying with the requirements shown on the "Application to Manufacture Septic Tanks".

It should be noted that a two compartment tank gives better treatment because better protection is given against solids carry-over to the discharge pipe. The final compartment of such a tank should be approximately one third of the total volume, with the interconnecting port, preferably a pipe bend, approximately two-thirds of the liquid depth from the bottom of the tank.

A minimum of 12" air space is required above the liquid level to allow for the accumulation of scum (mainly floating fats) and gases.

TABLE 3.1.2 - Recommended Dimensions of Concrete Septic Tanks

Liquid Capacity Imp.Gal.	Length (A)	Width (B)	Liquid Depth (C)
600	7'-0"	3'-6"	4'-0"
720	7'-3"	4'-0"	4'-0"
900	9'-0"	4'-0"	4'-0"
1000	9'-0"	4'-0"	4'-6"

(Tanks circular in plan are also permitted.)

Under certain circumstances a siphon chamber is required. Such a chamber doses the disposal field at periodic intervals. This allows the field to rest and recover absorbtive capacity. The chamber may be constructed integral with the septic tank or be a separate structure. (See section 3.7 and Appendix D)

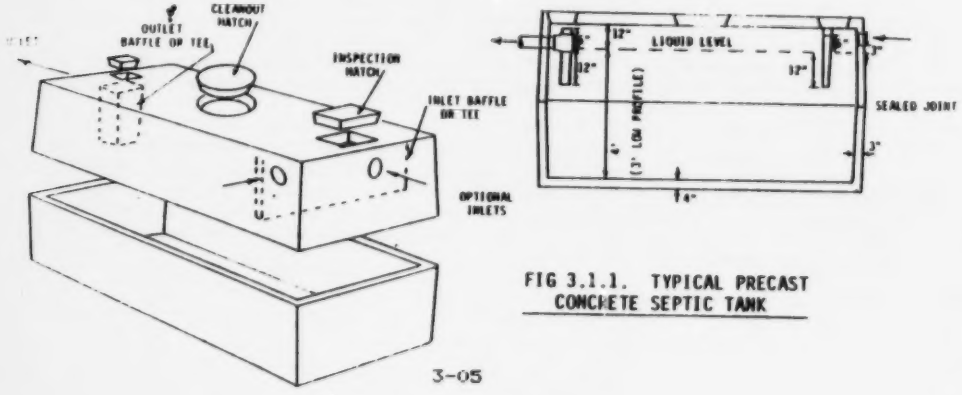


FIG 3.1.1. TYPICAL PRECAST CONCRETE SEPTIC TANK

3.2 Area Disposal Fields

An area disposal field is a rectangular shallow excavation filled with a layer of washed and screened gravel or crushed rock and fitted with a system of perforated pipes enabling the septic tank effluent to be absorbed into the soil. It is suitable for use in deep soils of medium to high permeability on flat or gently sloping lots with a low water table. Minor changes from previous regulations practice are recommended, principally in that the bed should be elongated and oriented with the greatest dimension of the bed across the slope of the lot. The area of the field is the critical design factor and the the requirement for length of distribution pipe has been reduced, recognizing that the gravel bed will distribute the effluent over a considerable distance.

Recent research has shown that the rectangular (almost square) area disposal field has disadvantages in that it is difficult to establish and maintain unsaturated conditions beneath the centre of the field. This leads to unsatisfactory effluent treatment. Wherever possible the multiple trench or contour disposal field is to be preferred.

Table 3.2.1 specifies the area of the field required per gallon of effluent to be treated per day for various soil types, with the total area required for a typical three bedroom family home and the suggested minimum cross slope dimension. Figure 3.2.1 shows details of typical bed construction and preferred layout for a typical lot.

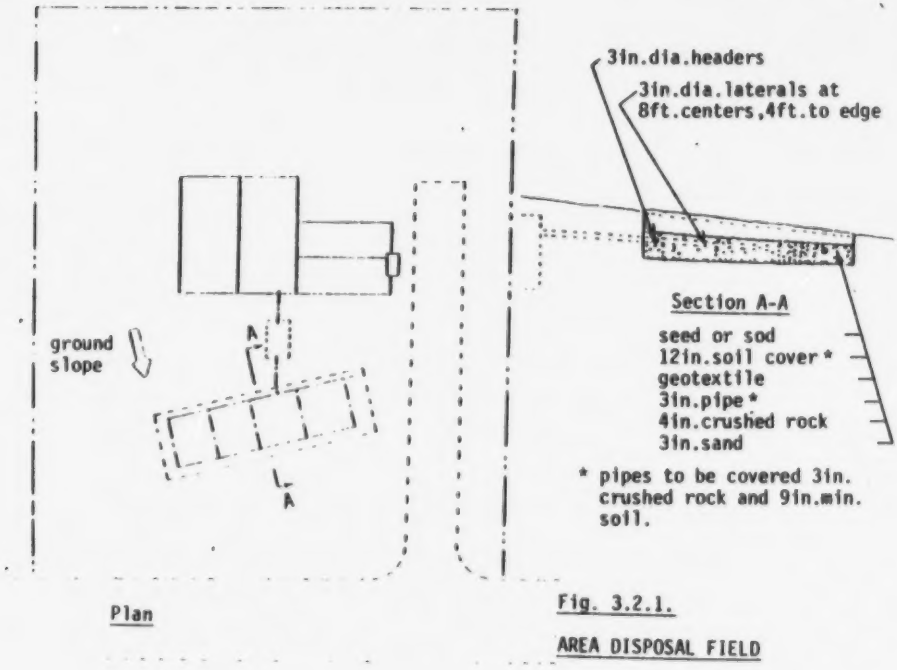
Table 3.2.1 Design Parameters for Area Disposal Beds.

Design flow	35 gal/person/day
Minimum occupancy	2 person/bedroom
Minimum depth of permeable soil	3 feet

Soil Type	Typical Perc.rate (min/inch)	Loading Rate (sq.ft./g/d)	field Area 3 Bed.Home (sq.ft.)(3)	Min.Cross Slope Dimension (1,3) (feet)
Sandy Gravel (2)	1- 5	3.5	735	45
Silty Sand	3-20	4.6	965	60
Sandy Silt	10-40	5.7	1200	75
Clayey Silt	20-60	6.8	1430	90
Silty Clay	Area disposal field not suitable			

Notes. (1) Cross slope dimension should be as long as lot dimension permits.
(2) May require imported fill contour or mound disposal field.
(3) For larger homes increase in proportion to number of bedrooms.

Elevation



Plan

Fig. 3.2.1.

AREA DISPOSAL FIELD

3.3 Multiple Trench Disposal Fields.

A multiple trench disposal bed is basically a network of hand or machine dug shallow trenches containing perforated pipe, screened and washed gravel or crushed rock and possibly sand enabling the septic tank effluent to be absorbed into the soil. More efficient than the area bed, it is also suitable for use in deep soils of medium to high permeability on flat or gently sloping lots with a low water table. Some minor changes in design from previous regulations are recommended based upon observation of failing systems. The trenches should be oriented with the greatest dimension across the slope of the lot and where laterals run in the direction of the slope, the laterals are to be joined with a second header pipe (perforated) connecting the lower ends. This pipe should be laid in a trench that follows as nearly as possible a contour,i.e. across the slope, with the bottom of the trench,the gravel bed and perforated pipe laid truly level.

Table 3.3.1 specifies the length of trench required per gallon of effluent per day for various soil types with the total length required for a typical three bedroom home. Figure 3.3.1 shows details of bed construction and preferred layout of trenches on typical lots.

Table 3.3.1 Design Parameters for Multiple Trench Disposal Fields.

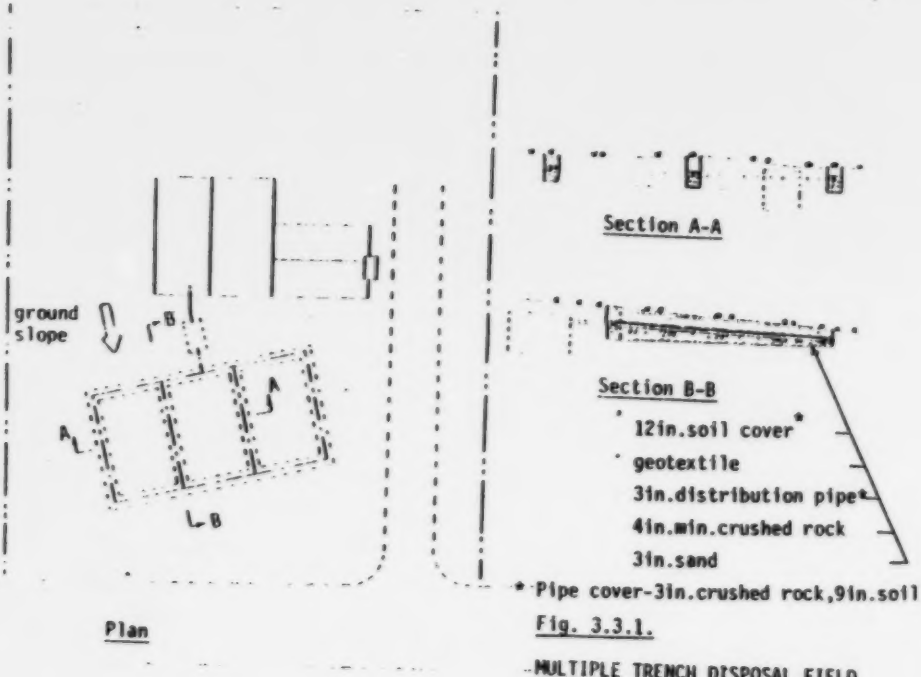
Design flow	35 gal/person/day
Occupancy	2 persons/bedroom
Minimum depth of permeable soil	3 feet

Soil type	Typical perc.rate (min.)	Loading rate (ft/g/d) (1)	Trench length (3 bed.home) (total ft.) (4)	Min.Cross Slope Dimension(ft) (2,4)
Sandy gravel (3)	1- 5	0.9	190	45
Silty sand	3-20	1.1	230	60
Sandy silt	10-40	1.4	300	75
Clayey silt	20-60+	1.7	360	90

Silty clay - Not suitable for multiple trench disposal field.

Notes
1) Based upon trench width of 2 ft.
2) Cross slope dimension should be as long as lot permits.
3) May require imported fill contour or mound field.
4) For larger homes increase in proportion to number of bedrooms.

Elevation



Plan

Fig. 3.3.1.

MULTIPLE TRENCH DISPOSAL FIELD

3.4 Contour Trench Disposal Fields (type C1)

The contour trench disposal field is a relatively narrow and shallow disposal bed constructed in a trench of constant depth, dug by machine or hand, with both the trench bottom and the lip of the trench wall at the ground surface absolutely horizontal throughout the entire length. That is, the trench is dug along a contour of the ground surface. The bed consists of a layer of coarse clean sand (to improve the filtration characteristics), a reduced thickness of screened and washed gravel or crushed rock and a single perforated effluent distribution pipe.

The contour field is suitable for lots with more than one foot of clayey silt or greater permeability soil with a slope of 5% to 30%. The contour concept can be extended to moderately high system loads such as small institutions and cluster community systems within the context of a Wastewater Management District.

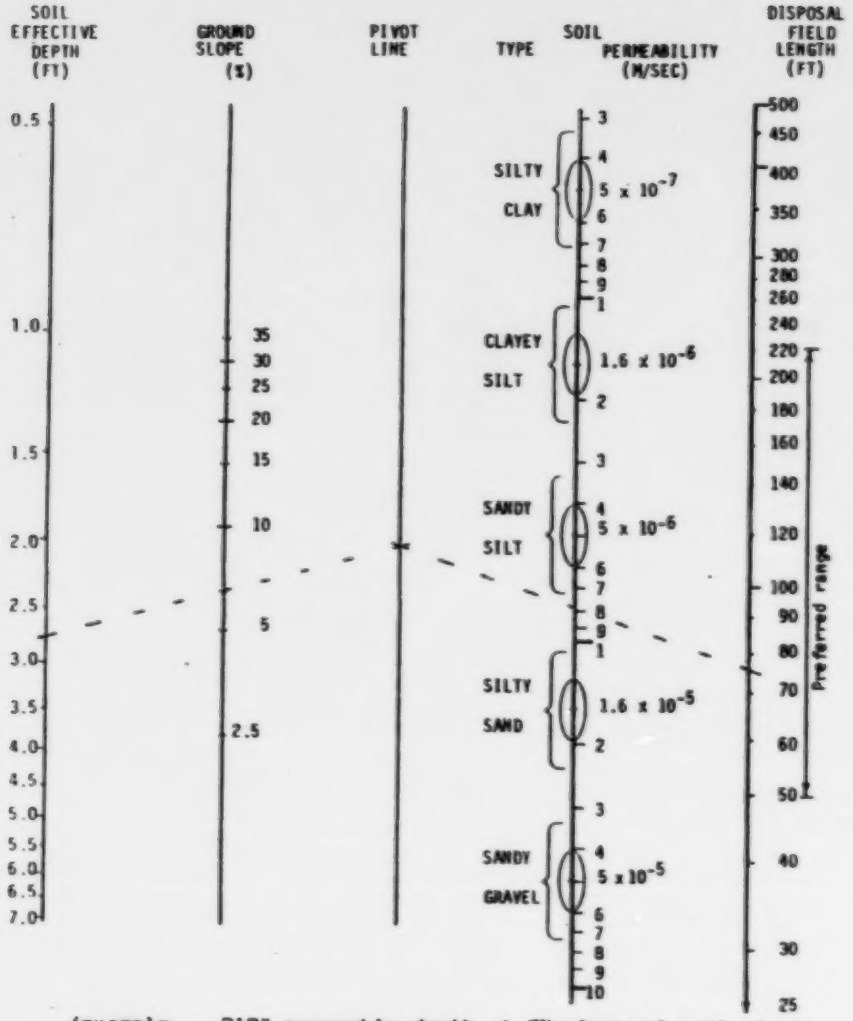
Design of the system is more critical than for area bed or multiple trench systems. The area of the trench is dependant solely on the daily flow of effluent and is set at 1.5 square feet of bed per gallon per day. The length of the bed is dependant on the rate that the effluent can flow away down slope within the soil. The rate is dependant upon the depth and permeability of the soil and the slope of the groundwater table.

A contour bed may be designed from first principles using standard formulae for the flow of water in soils and the measurements of soil depth, permeability and slope taken on site. In the absence of other data the system may be designed utilizing Nomogram 3.4.1 and estimates of permeability made from observation of test pits supplemented by percolation tests. The required length of bed may be estimated by extending a ruled pencil line from the left hand scale of soil depth through the scale for ground slope to the pivot line. From this point on the pivot line a new pencil line is ruled through the center of the soil classification band on the permeability scale and the required bed length is read on the right hand scale. Judgement and experience may be used in selecting a permeability intermediate between the specified soil types.

Table 3.4.1 may be used instead of the nomogram.

The lower limit of bed length has been set at 50 ft., although where the soil is of medium high permeability a shorter bed may be theoretically possible. An upper limit of 225 ft. is suggested for a single family home. Where the line falls beyond 225 ft. it is to be expected that the effluent plume will move in the more permeable zone close to the surface at certain times of the year and an imported fill bed of type C2 or C3 (see next section) may be required depending on specific site conditions.

Nomogram 3.4.1 Contour Disposal Field Design
(single family home, 200 gal/day)



(example - 2'9" permeable depth at 7% slope of soil whose fines are judged to be approximately 50% silt & 50% sand requires a field length of 75 ft.)

Table 3.4.1 Contour Disposal Fields Types C1,C2,C3
Theoretical Design for Three Bedroom Single Family Homes.

Design flow 35 gal/person/day
Minimum occupancy 2 person/bedroom

A = Field length (feet)

Permeable soil depth (ft.)	Site slope - per cent.(%) 5.0	7.5	10.0	15.0	20.0	25.0	30.0
Sandy Gravel							
1 ft.	50	----------	----------	----------	----------	----------	50
2 "	50	----------	----------	----------	----------	----------	50
3 "	50	----------	----------	----------	----------	----------	50
4 "	50	----------	----------	----------	----------	----------	50
Silty Sand							
1 ft.	130	95	70	50	----------	----------	50
2 "	70	50	----------	----------	----------	----------	50
3 "	50	----------	----------	----------	----------	----------	50
4 "	50	----------	----------	----------	----------	----------	50
Sandy Silt							
1 ft.	450	300	220	150	110	90	70
2 "	220	150	110	70	60	50	50
3 "	150	100	75	50	----------	----------	50
4 "	110	75	60	50	----------	----------	50
Clayey Silt							
1 ft.	>500	----	>500	450	350	280	230
2 "	>500	450	350	230	170	140	115
3 "	450	300	230	150	115	90	75
4 "	345	230	170	115	85	70	50
Silty Clay							
1 ft.	>500	----------	----------	----------	----------	----------	>500
2 "	>500	----------	----------	----------	>500	450	380
3 "	>500	----------	----------	>500	375	300	250
4 "	>500	----------	>500	375	280	225	190

For larger homes increase the length shown in proportion to the number of bedrooms. The dimensions shown or calculated are to be considered a minimum. It is recommended that the contour field should be made as long as is convenient within the confines of the site.

B = Field Width (for loading rate of 1.5 sq.ft./g/d)

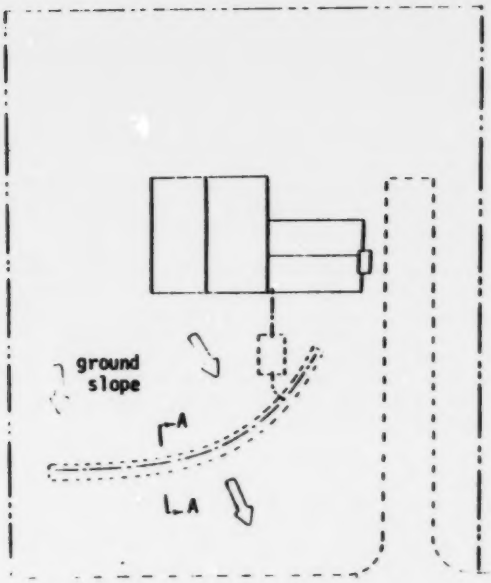
Field length (ft.)	50	75	100	125	150	175	200	225
Field width (ft.)	6.0	4.0	3.0	2.4	2.0	----------	----------	2.0

The nomogram and table are based upon the assumption that the hydraulic gradient is approximately parallel to the ground surface. Where there is a natural or artificial depression in the ground (e.g.ravine or cutting) within 50 or 60 feet of the disposal field, this will affect the hydraulic gradient. It should be remembered that, in general, permeability reduces with depth, but for reasonably homogeneous soils, the probable hydraulic gradient estimated from the local topographic features may be used in interpretation of the nomogram or table.

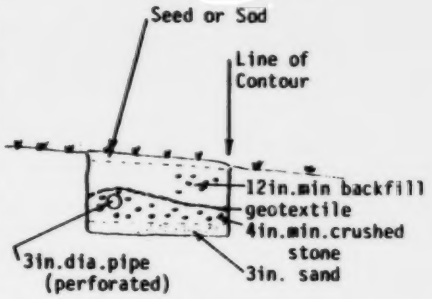
For contour disposal fields of 100 ft. or less, the field may be operated on trickle flow (no siphon or pump) using standard perforated pipe fed from the end or at the centre. A field of 100 to 150 ft. may also be operated on trickle flow if centre fed but for beds longer than 150 ft. see section 3.8 on pressure distribution systems. The perforated pipe should be situated towards the upslope side of the bed but where the bed is curved to follow the contour the pipe may be laid to a line that reduces the curvature of the pipe. The base of the excavation, the sand bed and gravel bed are to be truly flat and horizontal but the perforated pipe within the trench is to be laid to a gradient of approximately 1 in. in 25 ft. from the delivery pipe. Additional gravel will be required to support and surround the pipe. Where geotextile filter fabric is used to separate the cover soil from the gravel the pipe is to be protected by a 3 in. surround of gravel. Where building paper, straw or marsh hay is used for separation, the gravel is to be brought to a level 3 in. above the pipe for the whole width of the trench, as the soil will ultimately fall into the gravel. Above the gravel a minimum of 12 in. cover of soil is required and the soil should be immediately re-seeded or sodded to protect the soil from erosion by rainfall or run-off.

Details of construction and principle critical dimensions of the contour bed are shown in figure 3.4.1

Before starting construction the line of the contour should be set out using brightly marked pegs at 10 ft. centres. For trenches up to 100 ft. long a good quality hand sighting level is adequate but for longer trenches a builders tripod level should be used.



Plan



Section A-A

Fig. 3.4.1.

CONTOUR DISPOSAL FIELD TYPE C1

3.5 Imported Fill Contour and Mound Disposal Fields (types C2, C3 and M)

[Note: The following sections refer to the design of disposal systems for single family houses in generally category II & III building lots, but may apply to marginal conditions on category I lots. Systems for multiple units and institutions are beyond the scope of this document and should be referred to the Regional Public Health Engineer for guidance.]

3.5.1 General Principles

Maximum use is to be made of the infiltration capacity of the site to return as much of the effluent as possible to the groundwater regime. The imported fill placed over or under the distribution bed is to be designed to treat the excess effluent by filtration before it emerges from the base of the fill material.

In all cases the location of the disposal field is to be chosen to provide the greatest possible length along a contour that the dimension of the building lot will allow.

Imported fill contour disposal fields and mounds may be necessary on category I, II and III single family building lots. They may also be required for servicing commercial and institutional buildings or for clustered housing units. They may be required for the following reasons:

a) where there is insufficient depth of permeable soil over impermeable subsoil to install a fully trenched contour disposal field. (geometrical limitations)

b) where the topography and physical dimensions of the lot preclude the installation of the full length of trenched contour disposal field that would be required by following the design proceedure in section 3.4 (Hydraulic limitations)

c) where the permeability of the natural soil is too high (i.e coarse sand or gravel) or there is insufficient low permeability soil over fractured bedrock or course gravel which would allow effluent to reach the groundwater without adequate filtration to remove bacterial and other pathogens, thus, for example, endangering a well water supply. (Treatment limitations)

In all of the above cases except (c) it is assumed that the principle of lateral or horizontal flow of effluent will apply, due to the presence of impermeable or near impermeable subsoil conditions. Effluent will not enter the local aquifer immediately below the disposal field and the treatment of the effluent

will occur by filtration and absorption as it moves laterally through the natural soil or imported fill material. It is therefore considered that it is not essential to maintain a vertical separation of 3 feet between the distribution pipe and the ground water table or impermeable layer by providing a layer of imported fill beneath the crushed rock distribution bed. However in all cases involving condition(c) it will be necessary to provide the vertical separation to provide adequate treatment to the effluent as it travels vertically down to the aquifer.

To provide adequate treatment of the effluent in these less than optimum conditions it is important to attempt to provide for periodic re-aeration of the soil in the disposal field, by allowing for periods when excess moisture is allowed to drain from the system. Where there is adequate natural ground slope (more than 10%), it may be assumed that the field will drain down at times of low flow during the night. On almost horizontal lots a pressure distribution system may be required.

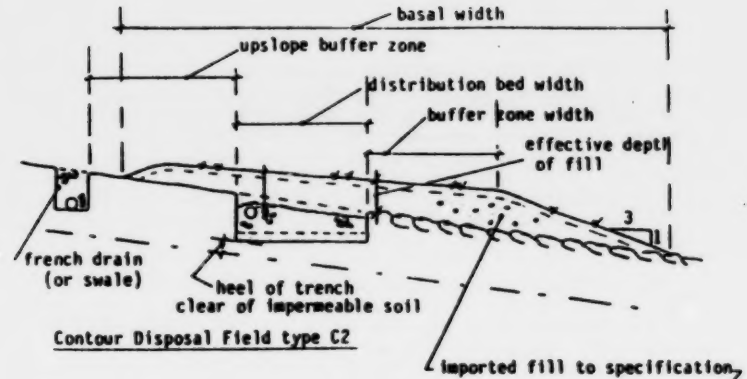
In cases (b) in which there are hydraulic limitations preventing the use of a fully trenched contour system it must be understood that during certain climatic conditions there may be some discharge of <u>treated</u> effluent from the base of the mound of imported fill. This discharge may form a thin film of liquid at the surface of the soil. If there is adequate vegetation and the bed is properly constructed the film flow will occur among the roots of the vegetation or grass and should not cause a problem.

A concentrated flow observed in one area does represent potential failure. The discharge should be along the whole length of the field and should disappear when drier conditions prevail.

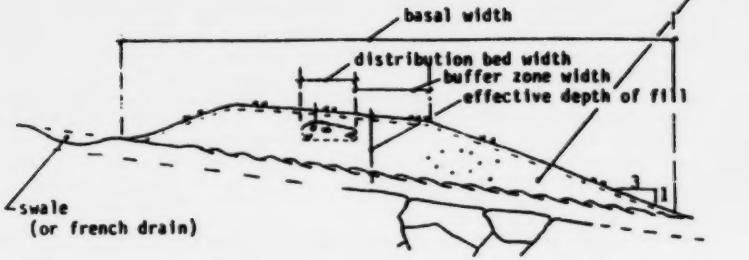
Where the natural soil slope is not constant there may be a tendency to concentrate effluent in the sections with the steeper slope. This again may require the use of pressure distribution by siphon or pump to relieve the situation.

3.5.2 <u>Selection of Disposal Field Type</u>

The type C2 contour disposal field (see figure 3.5.1) may be required for cases (a) & (b) discussed on page 3-15. In case (a) a fully trenched contour field type C1 would set the distribution bed of crushed gravel within the impermeable subsoil, leaving only the sidewalls of the trench as infiltration surface. The distribution bed is therefore raised to be wholly within the permeable natural soil (i.e. type C2) and the imported fill material is required to provide adequate frost protection. Although the effluent will, in theory, not reach the ground surface, it is considered that the fill material should meet the specification mentioned in section 3.5.3 (o).



Contour Disposal Field type C2



Contour Disposal Field type C3

Sequence through Distribution Bed from top surface

type C2	type C3
sod or seed on 3in. local soil	same as C2
min.12in. cover of fill to spec.	" " "
barrier material (geotextile)	" " "
3in.dia.distribution pipe	" " "
4in. crushed rock	" " "
3in. clean sand	(not required)
permeable natural soil	fill material to spec.depth
	ploughed or scarified surface
	subsoil or bedrock

Fig. 3.5.1 BUILT-UP DISPOSAL FIELDS

ELEVATIONS

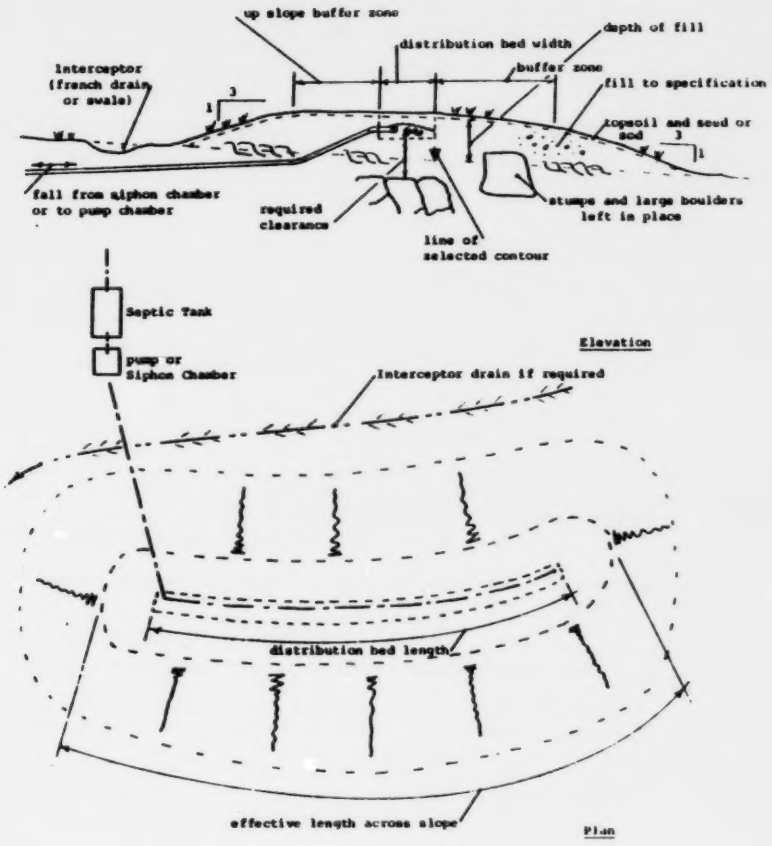


FIG. 3.5.2 MOUND DISPOSAL FIELD

Table 3.5.1 Contour Disposal Fields Type C2a
(12in.imported fill, 150% buffer width)

Recommended minimum length across slope (ft.) for three bedroom single family home.

Gradient %		5.0	7.5	10.0	15.0	20.0	25.0	30.0
Sandy Gravel	1 ft.	x	x	x	x	x	x	x
	2	x	x	x	x	x	x	x
	3	x	x	x	x	x	x	x
	4	x	x	x	x	x	x	x
Silty Sand	1 ft.	90	65	50	x	x	x	x
	2	50	x	x	x	x	x	x
	3	x	x	x	x	x	x	x
	4	x	x	x	x	x	x	x
Sandy Silt	1 ft.	300	200	150	100	80	60	50
	2	150	100	80	50	50	x	x
	3	100	70	50	x	x	x	x
	4	80	50	50	x	x	x	x
Clayey Silt	1 ft.	(see table 3.5.2)			300	230	180	160
	2	(***)	300	230	150	110	90	80
	3	300	200	150	100	80	60	50
	4	230	150	110	80	60	50	x
Silty Clay	1 ft.	(--see table 3.5.2 ----------						)
	2	(-- *	*	* ----------		)	300	250
	3	(-- *	*	* -)	340	250	200	170
	4	(-- *	*	* -)	250	190	150	125

Table 3.5.2 Contour Disposal Field Type C2b
(10in.imported fill,200% buffer width)

Gradient %		5.0	7.5	10.0	15.0	20.0	25.0	30.0
Sandy Gravel	1 ft.	x	x	x	x	x	x	x
	2	x	x	x	x	x	x	x
	3	x	x	x	x	x	x	x
	4	x	x	x	x	x	x	x
Silty Sand	1 ft.	50	50	50	x	x	x	x
	2	50	x	x	x	x	x	x
	3	x	x	x	x	x	x	x
	4	x	x	x	x	x	x	x
Sandy Silt	1 ft.	150	100	75	50	50	50	x
	2	75	50	50	x	x	x	x
	3	50	50	x	x	x	x	x
	4	50	x	x	x	x	x	x
Clayey Silt	1 ft.	250	210	180	150	120	90	80
	2	200	160	110	80	80	80	x
	3	160	100	80	80	x	x	x
	4	120	80	80	x	x	x	x
Silty Clay	1 ft.	350	320	290	260	230	200	180
	2	300	270	240	210	180	150	120
	3	250	220	190	160	130	120	120
	4	200	170	140	120	120	120	120

Notes

1) x-----x-----x means refer to preceeding table or nomogram as appropriate.

2) The figures given above are a guide to the minimum length for a disposal field. The field should be made as long as is practical within the site.

3) Where the available length is less than indicated by table 3.5.2 select a field type C3 or mound.

In case (b) the type of construction will be determined by the proportion of the effluent flow that may be expected not to be directly absorbed into the existing subsoil. This may be determined by referring to the nomogram 3.4.1 on page 3-11, or to Table 3.4.1 on page 3-12 . For the given site conditions (slope, depth & type of permeable soil) the nomogram or table will indicate the length of disposal field that is theoretically required to accomodate the effluent flow.

Where the available contour length for the disposal field is more than two thirds of the theoretical requirement then a type C2 disposal field with a depth of 12 in. of imported fill placed over the distribution bed, with a 50% increase in buffer zone width (Table 3.5.5), may be considered adequate. A guide to minimum recommended length is shown in Table 3.5.1.

Where the available length is less than two thirds of the theoretical requirement, a type C2 disposal field with a minimum depth of fill of 18in. should be provided, with the buffer zone indicated by table 3.5.3 increased by 100%. The minimum recommended length is shown in Table 3.5.2.

If these minimum recommended legths cannot be met, then a type C3 disposal field or mound should be designed.

In case (c) (potential contamination of ground water) either a type C3 or a mound disposal field will be required. The type C3 should be selected for lots with a slope exceeding 5% and the mound for essentially flat ground conditions.

3.5.3 Design Parameters

The dimensions and details of the disposal field shall satisfy the following criteria. Where different criteria indicate alternate dimensions, the greater dimension is to be selected.

a) The overall length of the imported fill disposal field along the contour, including the supporting end slopes shall be as indicated by nomogram 3.4.1, Table 3.4.1 or as discussed in section 3.5.2. Tables 3.5.1 and 3.5.2 indicate a minimum recommended length across the slope for type C2 contour disposal fields, with buffer width and depth as indicated.

b) The area of gravel or crushed rock distribution bed, including the sidewall area, shall be not less than as shown in table 3.5.3.

Table 3.5.3

Number of bedrooms	1 to 3	4	5
Distribution bed area in square feet	300	400	500

c) The basal area of the fill shall be not less than that shown in table 3.5.4.

Table 3.5.4.

Site soil type	Basal area of fill (sq. ft.) Number of bedrooms		
	1 to 3	4	5
Sandy gravel	600	800	1000
Silty sand	900	1200	1500
Sandy silt	1200	1600	2000
Clayey silt	1800	2400	3000
Silty clay	2400	3200	4000

d) The width of the buffer zone (edge of distribution bed to top of downhill slope) shall be as table 3.5.5.

Table 3.5.5

Length of crushed rock distribution bed, measured along contour	Buffer zone width
50 ft.	20 ft.
75 ft.	15 ft.
100 ft. or more	10 ft.

Where a type C3 or mound disposal field is built on a flat lot (i.e. with a slope less than 5%) and the elevation of the distribution bed is such that effluent may be expected to flow away from all sides of the field, then the buffer zone width may be divided between the two long sides of the field. (For example a 75 ft. long field may have two buffer zones of 7.5 ft. on either side.

e) The bed shall be oriented to distribute the effluent across the natural ground slope for as great a distance as is possible within the confines of the site., that is, a long narrow bed along a contour is preferable to a compact square bed having a short perimeter. The preferred length along the contour should be taken from the nomogram 3.4.1. or from tables 3.4.1, 3.5.1 or 3.5.2.

f) Clearance distances from boundaries, buildings, wells and water courses shall be as specified by a qualified person taking account of the regulations and guidelines.

g) A three foot vertical distance between fractured or fissured bedrock and the gravel distribution bed is required. The distance may include both natural soil and imported fill.

h) No fill material shall be placed to a greater depth than 4.5 feet from existing level to the finished level of the built-up bed, including cover soil.

i) A type C3 built-up disposal bed may be constructed either sloping or terraced to avoid excessive fill depth. In these cases, attention must be paid to effective distribution with serial or pressure system.

j) A disposal bed may be continued on either side of a driveway by connecting with unperforated pipe in the paved traffic area.

k) When a pressure distribution system is required, the distribution pipes should be fed by siphon or pump designed to flood the distribution bed twice per day. The length, layout and diameter of pipes and holes shall be designed on hydraulic principles. (See also section 3.8).

l) Where surface water flow may be expected at certain seasons to flow over the top of the bed, a french drain or ditch interceptor shall be constructed to divert this flow from overloading the bed. (See also section 3.7).

m) Original soil shall not be removed beneath the fill, but should be ploughed or scarified. Tree stumps should be left and cut off close to the original ground surface.

n) Where conditions are such that treated effluent may flow at the surface from the base of a mound or imported fill contour disposal field, depending on local topography, it may be advisable to extend a thin (3 to 6 inches) layer of permeable fill material covered by sod on the slope below the disposal field. This will contain or conduct the flow of effluent until it can be absorbed or masked by local vegetation.

o) Imported Fill Specification

The selection of the imported fill material is critical. The permeability should be neither too high nor too low. As measured in a permeameter, the permeability should be between 0.0005 and 0.00002 m/sec. (A simplified falling head permeameter test and required apparatus is described in Appendix C). Alternatively, the fill should consist of a reasonably uniform sand or sandy gravel containing a small proportion of silt. No more than 30% of the material should be retained on a 10 mm. (3/8 in.) sieve. A minimum of 2.5% and a maximum of 12.5% should pass the 0.075 mm. sieve (# 200 US std.).

This specification will ensure adequate filtration of the effluent without developing ponding within the bed. Where sod is not used to cover the completed built up bed, a 3 to 6 in. layer of more impermeable soil e.g. silty loam with topsoil, should be used to provide protection from rainfall and as a seed bed for grass.

It is considered to be the responsibility of the installer that the imported fill material meets these specifications.

p) Barrier Material for use in disposal fields.

An effective barrier material is desirable to prevent the silt in cover soil from washing or falling into the crushed rock distribution bed and thus causing a partial blockage. The barrier material should be of non-degradeable man-made fibre such as polyester or polypropylene of permeability greater than 0.001 m/sec. and with an opening size of less than 700 u.m.

This specification will normally be met with a light weight (50 g/sq.m or more) non-woven (i.e. felted, needle punched or heat bonded fibre) fabric or proprietry geotextile. The ability to stretch and deform is perhaps of of more importance than tensile strength. It should be noted that typical woven geotextiles of ribboned film have insufficient permeability and porosity for adequate aeration of the disposal field and for upward permeation of effluent in high water table conditons.

3.6 Leaching Chamber Disposal Fields

A leaching chamber disposal field is a system of proprietory pre-cast concrete units designed to replace the distribution pipe and crushed rock distribution bed of standard area and contour disposal fields. The units are placed in a trench excavated to 12 in. wider than the unit and prepared with a 3 to 4 inch layer of clean sand in the bottom of the trench. Installation and backfill must be carried out in accordance with the manufacturers instructions.

The number of units required should be determined by calculating the length of trench required for a contour disposal field for the particular site conditions (Nomogram 3.4.1 or Table 3.4.1). A check calculation is to be made to ensure that the loading rate of the trench containing the units will not be greater than 1.5 sq.ft. of trench per gallon of effluent per day.

The units are to be laid out to follow as nearly as possible the line of a contour, by inserting short lengths of pipe and/or bends between the leaching chamber units. Fig. 3.6.1 illustrates a typical leaching chamber unit and layout in a disposal field.

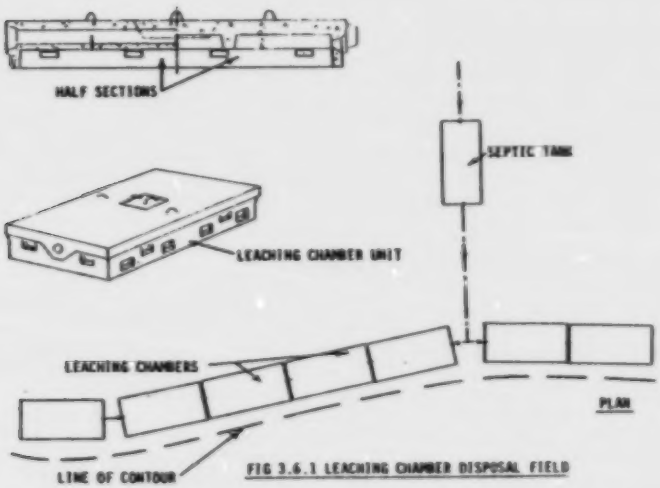


FIG 3.6.1 LEACHING CHAMBER DISPOSAL FIELD

3.7 Interceptor Drains

An interceptor drain may serve two functions. Firstly it may be required to prevent surface run-off from an uphill slope entering the disturbed and therefore permeable soil of the disposal bed. High surface run-off may be expected where topsoils are of low permeability and on other soils during snowmelt or heavy rainfall on frozen ground. The surface flow may be diverted by the construction of a shallow ditch arranged, on the slope above the disposal field, to divert the flow past the ends of the field. The ditchshould be approximately one foot deep and two feet or more wide and the base of the ditch should have a gradient of at least 5% . The ditch should be sodded but kept mown and clear of debris.

A second requirement may be to intercept a seasonal high level in the groundwater table in moderately permeable soils at the base of a long slope. In this case a french drain or land drain is required. The drain may be up to 4 feet deep but should be as narrow as possible. A perforated pipe is laid to a fall of at least 2% in the bottom of the trench and the trench then filled to the surface with the same specification of gravel used in the disposal bed. Filled to the surface with stone, the drain will also intercept surface flow. Aternatively the french drain could be combined with a shallow surface ditch.

Normally the interceptor will drain past either or both ends of the disposal field but for very long contour disposal beds the outlets from an interceptor drain may be required to cross the disposal bed at intervals. The crossings should be laid beneath the level of the disposal bed in unperforated pipe. Backfill of the interceptor drain should be mixed with approximately 5 to 10% bentonite powder for a distance of 3 feet upslope to 3 feet downslope of the disposal bed to prevent the drainwater from passing into the disposal bed and the septic tank effluent from leaking from the bed.

3.8 PUMPS, SIPHONS AND PIPEWORK

In most cases how the septic tank effluent is distributed through-out the disposal system is critical to acceptable performance and long life to the system. Uneven distribution can result in progressive clogging of the soil interface or inadequate treatment in rapidly permeable soils.

Essentially any system would work better if it were dosed from one to four times per day with resting periods in between. However, increased costs and maintenance requirements must be considered. Bearing this in mind, although dosing is recommended whenever possible, it is not mandatory for single family dwellings except in cases where a single line of the disposal system exceeds 150 feet in length. Where pumping is required due to the relative positions of basement, septic tank and disposal bed, the system must be designed as a dosing system.

Either a siphon or pump can be used to provide the required dosing, If site conditions will permit, the installation of a siphon is preferred to a pump, siphons do not require a power source and there are no mechanical parts involved, although a head loss of 2 feet or more can be expected with the use of a siphon.

One type of siphon, the Miller siphon, is shown in Fig. 3.8.1. For ease of maintainance, this includes a removable bell. As sewage enters the siphon chamber, air is trapped in the bell. As the liquid level continues to rise in the chamber, the air is pushed down towards the bottom elbow. When the level of water reaches a pre-determined depth the air is forced pass the elbow and sewage is drawn out of the tank to the bottom of the bell. This discharge volume depends on the type of siphon and the dimensions of the chamber.

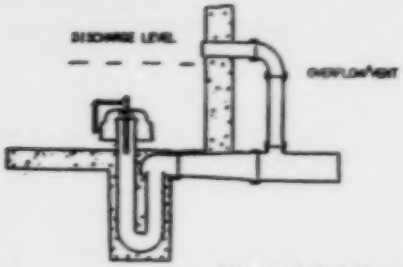


Fig. 3.8.1 Miller Siphon

An alternative type of siphon,constructed of PVC or ABS pipe and fittings is described in Appendix D.

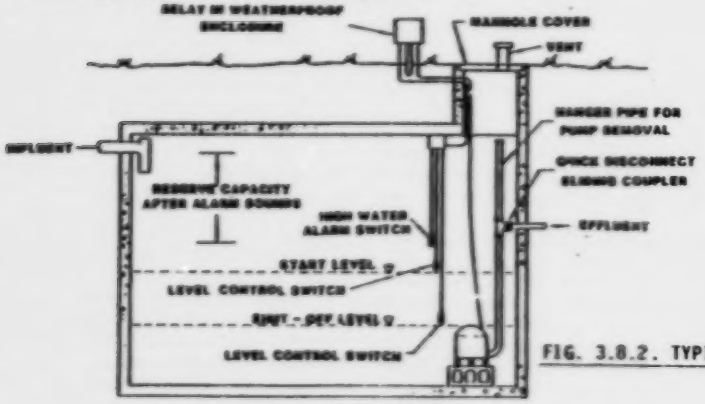


FIG. 3.8.2. TYPICAL PUMP CHAMBER

A typical pump chamber following the septic tank is shown in Fig. 3.8.2. The pump and controls must be suitable for operation in a corrosive environment. Pump size is based on the required dosing volume and flowrate, difference in elevation between pump and disposal bed plus friction losses in the pipe. To prevent freezing problems the line between the pump and the bed should drain by gravity back to the pump chamber. If this is not possible insulation or burial below 4 feet 6 inches will be required.

The actual design of a pressure distribution system is based on hydraulic principles and is beyond the scope of these guidelines. In an attempt to simplify design and standardize equipment requirements for single family houses, the required dosing capacity for siphon and pumps has been set at 100 imperial gallons where standard 3 or 4 inch perforated pipe is used in the disposal bed. The discharge capacity per cycle for pumping system would have to be increased to compensate for the backflow volume from the discharge pipe where this volume is significant.

The dosing chamber should be constructed of concrete, fibreglass or other non-corrodible material. To prevent overloading of the system the tank must be water tight and may require precautions to prevent flotation if installed in an area of high ground water.

The quality of piping used in a disposal system is an important consideration. It must be of adequate strength to resist shearing due to differential settlement and durable enough to remain intact for many years. In the past, problems have been encountered with poorer quality solid and perforated pipe. In order to eliminate this the requirements for pipe quality have been made more stringent. The quality of pipe required is dependant upon the location of the pipe and the external load to which it will be subjected, which may include loading during construction due to wheeled machinery.

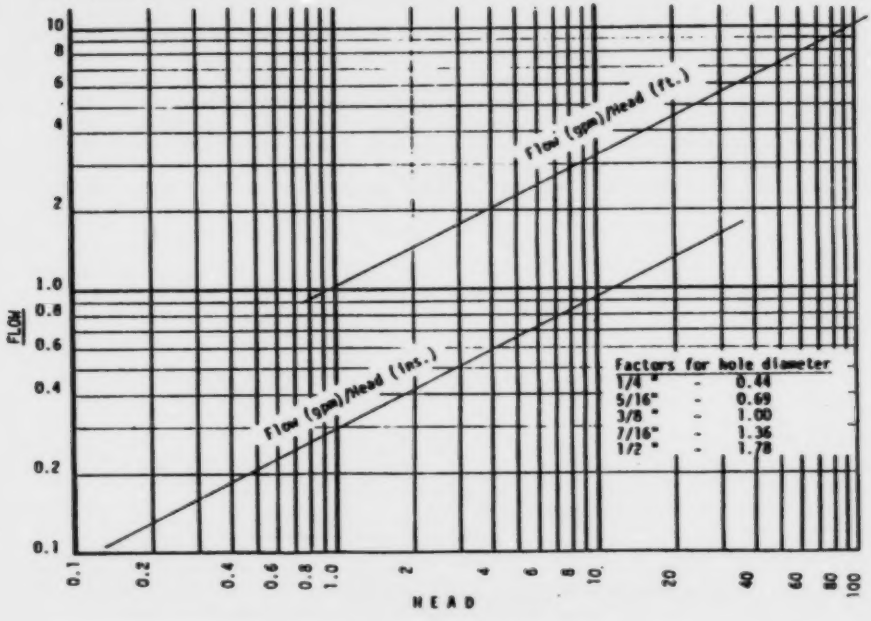
For gravity systems it is now necessary to have all the lines from the house to the tank, from the tank to the disposal field and within the disposal field, of either PVC or ABS plastic to Canadian Standard C.S.A. B182.1 and with a dimension ratio (SDR) not exceeding 35. The use of other plastic materials of equivalent or better specification may be considered if a request is made in writing to the Director of Public Health Engineering.

In a gravity distribution system the pipe shall have a minimum diameter of 3 inches laid to a slope of 2 to 4in. per 100ft. The invert of the pipe shall be perforated with a 3/8in.dia.hole every 10 to 14 feet. The sides of the pipe shall be perforated with 3/8in.dia. holes set at 60 degrees to the invert at a spacing of 3 to 4 feet. on one side or alternate sides. The invert holes will effectively distribute the majority of small sewage flows of 2 to 5 gallons, the side holes will also disperse the larger flows.

For contour disposal systems type C1 or C2, a trickle flow distribution system direct from the septic tank is acceptable for up to 100 feet of pipe if it is end fed. A pipe up to 150 feet long may also be trickle fed if fed from the centre. A longer length will require a pressure distribution system. Better distribution of effluent will be achieved on a trickle fed system if the pipe is laid to a gradient of at least 4in. per 100ft. with the first five pipes (or centre six) twisted approximately 1in. off centre, i.e. with the bottom holes 1in. to one side.

Piping in a pressure distribution system following a pump shall be equivalent to the requirements of section 2.5.6(1) of the Canadian Plumbing Code regarding P.V.C. water pipe.

Unless supported by the hydraulic design, for a pressure distribution system, the holes in the perforated pipe shall be 3/8 inch in diameter, be uniformily spaced with a maximum hole spacing of 10 feet. Additional holes in the side of the pipe are not required. The slope on the pipe should be a minimum of 2 inches per 100 feet.



Perforations in distribution pipe - Head/Discharge relationship for 3/8" dia.hole.

4 CONSTRUCTION

4.0 General

The proper construction or installation of the disposal system is the key to long term satisfactory performance. Regulations, site inspection, and design may all be adequate however, if installation is poor a homeowner and the neighbourhood may be faced with a serious situation resulting from the health and aesthetic problems associated with a malfunctioning system. It is now a requirement of the majority of the boards of health that professional installers be licensed. A home owner may be permitted to install an area or multiple trench disposal field on his own property but, for the istallation of the newer designs of contour disposal fields and mound systems, construction must be by a licensed installer. If you are planning to hire an installer you should be sure he is licensed if it is a requirement in your municipality and check out other sources of information such as previous customers, etc.

The elevation of the trench bottom, finished grade over the bed, septic tank, building sewer and elevation of the point where the building sewer enters the building are all dependent on the elevation of the pipe in the disposal bed. The elevation of the pipe as related to existing grade will be given with the design on the permit. A check should be made calculating the elevation that the sewer must exit the basement wall and a decision made as to whether a) to set the basement floor above this level, b) to limit the use of plumbing facilities in the basement or c) to pump the sewage to the disposal system. See Fig.4.0.1.

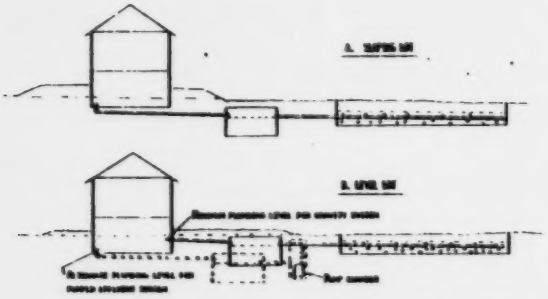


FIG. 4.0.1 MINIMUM PLUMBING LEVELS

The finished grade of the field and surrounding area must be sloped to divert surface water and the entire area sodded or seeded to prevent erosion and encourage water dissipation through evapotranspiration.

4.1 Septic Tank

The vast majority of septic tanks installed in the province today are precast concrete. A typical precast tank with minimum dimensions specified is shown in Fig.3.1.1. To give 800 gallons liquid capacity,the dimensions A, B,and C of the tank shown would be approximately 4'0", 8'0", 4'0" respectively. The design of any prefabricated septic tanks must be approved by the Department of Health. Tanks must be constructed of concrete, or other non-corrodible material. The use of metal tanks is prohibited. A person can construct their own tank on site, although this is seldom done due to the limited cost savings. Anyone planning to build a tank should have the plans approved by the Department.

Easy access to the tank is very important to facilitate routine or emergency maintenance. If the tank is more than 18 inches below ground surface, manhole rings and a manhole cover should be installed over the main access cover to allow easy access and to keep the amount of excavation required to minimum. For the safety of children, the manhole cover or slab should still be covered by a few inches of soil and turf.

A full 600 gallon concrete tank will weigh more than six tons. It is important to have it on sound bedding material to avoid settlement. The excavation should be kept as close to the grade of the bottom of the tank as possible with any large stones removed and any depressions filled with gravel. Special precautions outlined by the manufacturer are required when installing a fiberglass tank. No tank can be placed on fill unless the subsoil is adequately compacted with vibrating type compactors.

A fairly common problem is the shearing of the line from the house to the tank, either at the tank or at the foundation, due to differential settlement. Proper bedding of the tank and sewer line will help eliminate this problem but,even with the use of SDR 35 or equivalent strength pipe, it is recommended that additional flexible joints be provided adjacent to the basement wall and septic tank.

4.2 Avoiding Soil Damage during Construction

Concerns regarding soil conditions apply to the construction of all types of systems. Smearing or compaction of the soil interface is the most common and destructive damage encountered. In order to maintain the permeability of a soi the voids, mentioned previously when discussing soil texture and structure (section 2.3), must not be destroyed. It is essential to prevent the soil interface, i.e., the top of the natural soil below the disposal field and the sides of the excavation, from being smeared or compacted. Smearing is most serious the higher the clay and moisture content of a soil. It can occur when machinery such as

a dozer blade or backhoe bucket slides over the interface. The moisture in the soil acts somewhat like a lubricant allowing the clay particles to slide over each other sealing off the voids in the soil below. Compaction in the form of the wheels of a machine or even footsteps reduces the size and number of the voids at the interface which results in a corresponding reduction in permeability.

The best way to keep smearing to a minimum is to not work on the construction of a field when moisture content is high. Unfortunately, this means that at times in the spring as well as at other wet periods, conditions are just not suitable for installing a system. This cannot be avoided in our climate. The type of machinery used also influences the amount of smearing. Excavation with the blade of a dozer where the material is pushed out tends to smear more than digging out with a backhoe bucket. The use of a dozer where the machine travels back and forth over the interface also results in undesirable compaction. If the material is dug out with the machine sitting on unexcavated material then the interface is not compacted. After the excavation is made it should not be left uncovered for extended periods of time to reduce compaction due to heavy rain, machinery or people on the interface. If an interface is smeared or compacted, some of the damage can be undone by handraking. It is recommended that all disposal field excavation be handraked.

Another point to remember is that in many cases the effluent from a system will have to move laterally from the field before it infiltrates into the subsoil. If this movement is downslope from the field and machinery has driven back and forth compacting the permeable topsoil down grade from the system, the effluent may break to the surface at this point. It is recommended therefore, that, if at all possible, machinery be kept upgrade of a system.

4.3 Conventional Disposal Fields

A conventional disposal field used in Nova Scotia refers to a multiple trench or area disposal field system laid out on a square or rectangular shape with for example 4 lines 60feet long at four foot centers. See figure:4.3.1.

Some areas of the province presently use almost all trench systems whereas other districts use the area bed type. A multiple trench system is preferred to an area bed system because of reduced chances for smearing and compaction. The trench system also has a much higher ratio of side wall area to bottom area. Research has shown that side walls do not clog from biological mat formation as quickly as bottom area.

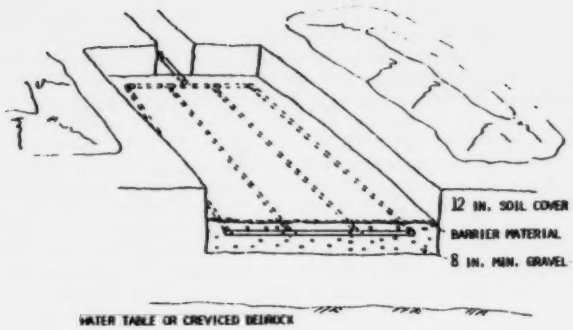


FIG. 4.3.1 AREA BED DISPOSAL FIELD

If trenches are relatively close and narrow the preferred method is to excavate one trench, install gravel and pipe then use the material excavated from the second trench to backfill the first, but leaving the ends of the pipes exposed for inspection.A bed system is usually totally excavated at one time with a small dozer, the gravel placed to pipe invert grade, the pipe placed, covered with gravel, covered with a permeable barrier and backfilled. The bottom of the trench or bed should be level in all directions, and free from smearing or compaction.

4.4 Contour and Imported Fill Contour Disposal Systems

The contour disposal system is based upon the principle that both natural and effluent groundwater must flow laterally and in the direction of ground slope. To obtain optimum results a long and narrow disposal system is constructed along a contour (points of equal elevation) of the site. The effluent plume disperses into the subsoil and filters downslope along a very broad front instead of being concentrated into the very short perimeter of the conventional disposal bed.

Although the design of the contour disposal system is simple in concept its success is dependant upon high construction standards. It is imperative that the extended length of the system be horizontal at the edge of the excavation and that the crushed rock and distribution pipework be installed with some precision. The proper performance of the system is also dependent on the interception of surface water and shallow groundwater upslope of the disposal system. This aspect will be addressed in section 4.7.

As outlined previously, the depth of permeable soil will determine at what level the contour system will be placed. If a filled contour system is required the area has to be cleared and the required fill placed.

The following procedure then generally applies to all contour systems:

a) Excavate a level trench at the required depth, width and length (refer to section 3.4 and table 3.0.2).

b) Rake the sides and bottom of the trench to remove the smeared and compacted soil

c) Spread 3 inches of clean coarse sand the entire width of the trench

d) Spread a minimum of 4 inches of clean washed gravel or crushed rock the entire width of the trench

e) Place the perforated pipe on the crushed rock at a distance of one foot from the upper side - ensure that the holes in the pipe are correctly oriented (see section 3.7 for drilling pattern).

f) Starting at the end of the pipe remote from the inlet, now raise the pipe to the required minimum grade, supporting the pipe as necessary with additional crushed rock.

g) When geotextile is used to separate the cover soil from the crushed rock the pipe is to be protected by 3 inches of crushed rock

h) At this point the system should be inspected by a Public Health Inspector.

i) When approved, the system should be carefully back filled. As noted in section 4.2, machinery should be kept upgrade of the system.

The construction of a built-up contour disposal system requires additional special measures to those outlined above. Please refer to section 4.2 dealing with soil damage during construction.

4.5 Mound Disposal Fields

The mound disposal bed has been used on lots where there is an inadequate depth of permeable soil over bedrock or ground water table. It is based upon the principle that flow downwards and laterally through several feet of permeable fill will provide adequate treatment of the effluent.

The physical layout of the mound bed has been revised from the 1980 regulations as a result of experience and observation. These have indicated that it is not only the depth to water table or impermeable soil that is of importance for the proper operation of this type of disposal system. The slope of the lot, the construction methods used, the type of soil and the amount of buffer soil placed have been shown to be very critical for a built-up bed.

If a mound bed is to be constructed in a cleared area the soil should be scarified or tilled. If the area is treed, the trees should be cut at ground level and the area around the stumps scarified or ploughed.

The required fill should then be placed in the disposal area with the least disturbance to the soil; i.e. heavy equipment traffic is to be restricted. The fill should be dumped at the perimeter of the area and put into place by means of small equipment. If smearing has occurred during placement it should be removed by hand raking. The sand, if required, and the crushed rock should be placed using the same precautions as for placement of the fill. The pipe should then be covered with crushed rock and geotextile, then carefully backfilled with acceptable soil. The provision of an adequate buffer is very important for proper operation of the system. The cause of many failures of mound beds in the past has been attributed to insufficient soil being placed at the perimeter. The amount of soil required will be determined by the qualified person.

To finish the system it should be sodded or seeded.

Should the slope of the land result in an excessive depth of fill a sloped or terraced system may be recommended.

4.6 Leaching Chambers

The construction of a leaching chamber disposal field shall be carried out strictly in accordance with the licensed manufacturers instructions. Particular attention should be paid to the need to keep the bottom of the excavation absolutely level, with both the bottom and the sides raked free of any smearing. Wherever possible the system should be laid out with the downslope side along a natural contour.

4.7 Interceptor Drains

The use of contour disposal systems (and possibly other systems) will require that surface water and possibly shallow groundwater be intercepted upslope of the system. An interceptor drain should be constructed approximately 10 feet upslope of the disposal area. If a ditch or swale is used, it should be aminimum of one foot deep and at least two feet wide, sodded with sloping sides to permit mowing or removal of weeds.

Where a french drain is used, it should have a width of 1 to 2 feet, a depth of 1 ft.6 in.or more or to impermeable soil (or bedrock) and of sufficient length to adequately divert water from the disposal system. The trench should be filled with crushed rock (minimum 1/2 inch in size) to the top of the ground surface. The trench should not be sodded or fill placed over it as this will seal the trench. A slight grade should be given to the interceptor to ensure that it functions properly. Outlets should be at both ends and possibly at intervals along its length. Roof water discharges should not be directed into the interceptor as this will place an unnecessary load on the system.

Special precautions have to be taken to ensure that water from the interceptor does not enter the disposal system or flow from the disposal system by following the disturbed soil outside the pipes. Figure 4.7.1 indicates 5 areas where this could occur. At these areas the soil around the pipes should be sealed with bentonite. Such precautions may be required elsewhere in different circumstances.Crossings should be avoided if at all possible at single family homes.

Again, it is emphasized that traffic must be restricted to the upslope side of the disposal area during construction of interceptor drains.

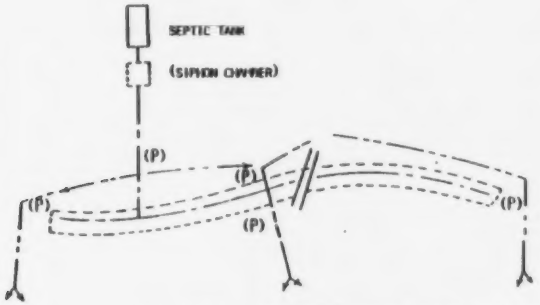


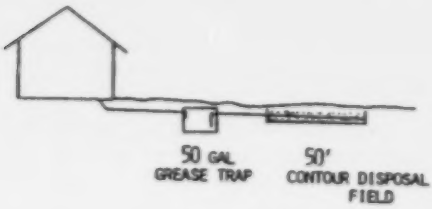
FIG. 4.7.1 INTERCEPTOR DRAIN PROBLEM AREAS (P)

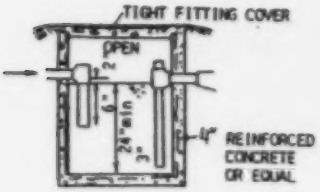
5.0 OTHER SYSTEMS

5.1 Greywater Only

Greywater, any household waste water other than that produced by toilet facilities, can be a serious aesthetic and health problem if not disposed of in an acceptable manner. (see regulation 16)

In certain cases such as isolated hunting camps where the lot has been assessed as suitable for on-site sewage disposal and a privy or other suitable non water carrying system is proposed, a system of some type is still required for greywater, i.e, sink wastes disposal. The details of the required system will be shown on your permit, but one type of system is shown in figure 5.1.1. It must be stressed that this type of system will not handle waste from washing machines, dishwashers, etc., but is only intended for infrequent use of sinks and possibly showers. If the Department feels the installation of such a system could contaminate groundwater or create a health or asthetic problem, approval of such a system will not be recommended.





SECTION - GREASE TRAP

FIG. 5.1.1 - GREY WATER SYSTEMS

In the case of a full time residence which has a non water carrying toilet a standard on-site disposal system would be required for grey water. The size requirements for this type of system would be the minimum required for a single family home.

5.2 Privy and Other Non Water Carrying Toilets

The flush system has become the standard receptical for human waste. However, non water carrying systems are used to a limited extent in seasonal dwellings, for reducing hydraulic loading on malfunctioning disposal systems, replacement of existing privies by indoor non water carried systems and at campgrounds.

These systems do not dispose of the greywater or household wastes other than toilet wastes and are not a complete disposal means even for the toilet wastes. Included in non water carrying system are the privy, electric or gas incinerating toilets, humous or composting toilets and chemical toilets. Problems such as odors, maintenance, and flies have been reported with all these disposal systems. It is presently felt by the Department that at some time in the life of a newly constructed residence the present or future owner will want to install a water carried system.

Considering the need to dispose of greywater and to allow future conversion to a water carried system, the Department does not recommend approval of a lot for new construction unless it is suitable for a septic tank disposal system even when a non water carried system is proposed. If the lot is recommended and a permit issued, the homeowner can install a non water carried system if he wishes.

Examples of acceptable privy construction are shown in Appendix B.

6.0 MAINTENANCE REQUIREMENTS

6.1 General Maintainance.

Proper routine maintenance is a key to long term satisfactory operation of an on-site sewage disposal system. This is the responsibility of the owner. Unfortunately, too few people realize the importance of regular maintenance and it is only carried out when a problem arises and irreversible damage has been done to the system. In fact some people purchase homes with on-site disposal systems and do not even know such a system exists until they have problems.

In order to get optimum performance out of your system, please note the following:

a) When the system is being installed, reference the location of tank and field to some permanent markers.

b) Do not overload the hydraulic design of the system. Keep water consumption to a minimum and repair leaky faucets or toilet tanks.

c) Do not allow large quantities of fats, plastics, or chemicals to enter the system.

d) Have your septic tank pumped when required. The required frequency depends on the habits of the household and tank capacity, but 3 to 5 years is suggested. The tank should be inspected every 2 years.

e) Never enter a pumped tank unless it is mechanically vented. The gases present could be fatal.

f) Routinely check operation of pumps or siphons, if any are used.
g) Remove any large trees from the immediate area of the disposal field to prevent roots from clogging the pipes.

h) Maintain sod cover over the disposal field to prevent erosion and increase water dissipation through evapotranspiration.

i) Do not allow vehicles to drive over the disposal field.

j) Divert roof drains and surface drainage away from the area of the disposal field.

6.2 Rehabilitation

A permit is required from the Board of Health to rectify a malfunctioning system. Normal lot assessment procedures may not apply, but such will be determined by the qualified person.

When an on-site sewage disposal system has been found to be malfunctioning, the first step which should be carried-out is to try to determine the cause of the failure. Because systems are below ground, however, this is often very difficult, if not impossible, to detect.

Attempts should be made to determine if the failure is due to environmental (bedrock, poor soil, high water table, slope), design, installation and/or maintenance problems (systems too small, poorly maintained, incorrectly installed) or a combination of the above. The cause of the failure and the land available for rehabilitation will determined what remedial measures can apply in each case.

A system which malfunctions after many years as a result of poor maintenance is very hard to rehabilitate. Hydrogen peroxide can be used to break up the clogging mat but large amounts are required and the beneficial effects are doubtful. The manufacturers application procedures should be followed if the process is to be used.

Should a new system be required but not enough land is available, the existing system may be extended. Bearing in mind the principles stated in previous sections, an extension to the existing field should be laid out to provide as much length across the slope as the lot will allow (see fig. 6.2.1.) If the lot is sloping and the extention is to be placed at a lower elevation, the new system should be connected to the existing system by means of an "overflow system" as indicated in fig. 6.2.2. This will allow the first field to function normally and the second field will handle the overflow.

Should the malfunction be due to environmental problems, the situation has to be carefully assessed. A contour system of type C2 or C3 should be given consideration in an attempt to distribute the effluent over as long an area as possible. Should the lot be level, a mound bed may be used if the area is available. In some instances it will be impossible to recommend a replacement system because of inadequate lot area.

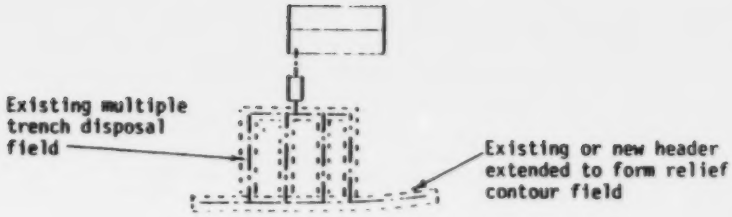


Fig. 6.2.1. - Rehabilitation - Multiple Trench Disposal Field

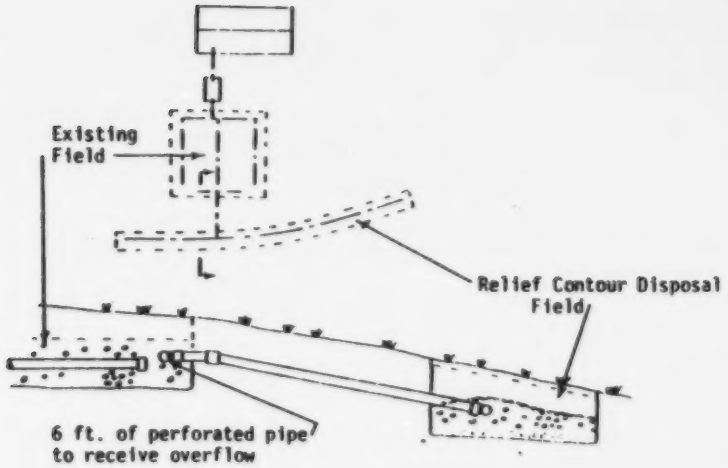


Fig. 6.2.2. - Rehabilitation - Area Disposal Field

7.0 GENERAL

7.1 Large On-Site Disposal Systems

Depending on site conditions, on-site disposal may be suitable for large facilities such as schools, restaurants, firehalls, etc. As was the case with individual houses the site and layout of the disposal system will depend upon estimated hydraulic loading, soil type, slope and other site conditions. In many cases for very large systems, it is advantageous to engage a qualified consultant to design and supervise installation of the system. In any case a permit to install an on-site system is still required before installation commences.

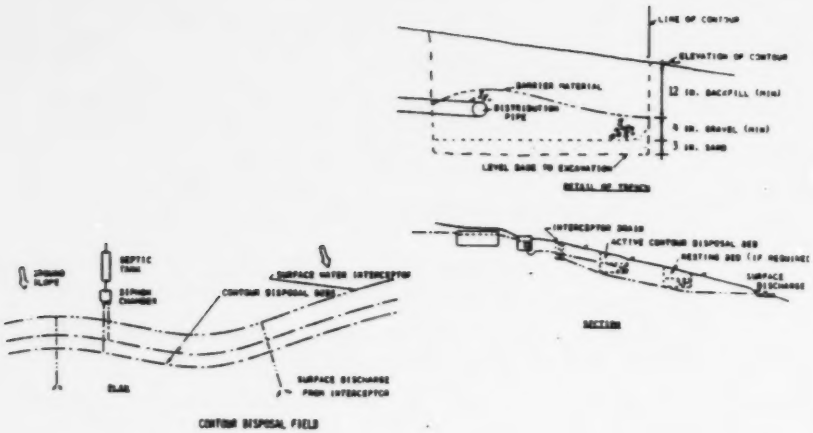
7.2 Waste Water Management Districts

Legislation was passed in 1982 permitting a municipality to establish a utility to manage all wastewater disposal systems within a designated area, whether these systems are privately or publicly owned. The area so designated is called a Wastewater Management District.

Although not restricted to existing communities, the main objective of the legislation was to allow alternatives to conventional central sewer systems as the only method of eliminating malfunctioning disposal systems in existing communities. In recent years the costs associated with the installation and maintenance of central sewerage systems has become prohibitive in many cases. In some cases the creation of a Wastewater Management District can result in substantial cost savings.

The solution to a problem in such a district could include some individual on-site disposal systems plus cluster systems (see figure 7.2.1) with the utility responsible for all operation and maintenance of these systems.

If you or your community would like further information on waste water management districts, please contact your local Department of Health office.



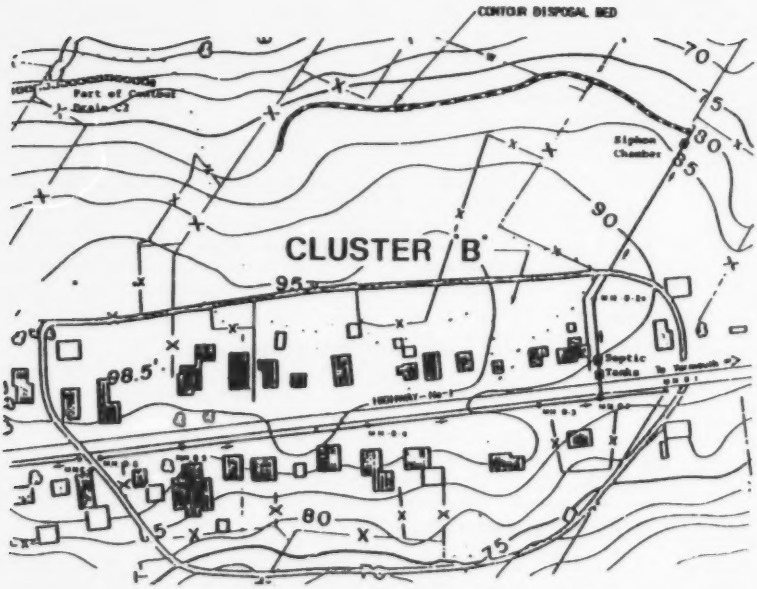


FIG. 7.2.1 TYPICAL CLUSTER SYSTEM (PORT MAITLAND)

APPENDIX A

REFERENCES

1. U.S. Environmental Protection Agency, "Design Manual - On-Site Wastewater Treatment and Disposal Systems", Office of Water Program Operations and Office of Research and Development,October 1980 EPA 625/1-80-012

2. U.S. Department of Health, Education and Welfare,"Manual of Septic Tank Practice", 1957

3. Otis R.J.,"Treatment and Disposal of Small Wastwater Flows : Workshop Manual", Rural Systems Engineering, Madison 1981

4. Healy K.A.,Laak R., "Factors Affecting the Percolation Test", Journal W.P.C.F., Vol.45, July 1973

5. Province of Nova Scotia, Department of Health, "Regulations Respecting On-Site Sewage Disposal Systems", 1985

6. Province of Nova Scotia, Department of Health, "Regulations Respecting Subdivision of Land to be Serviced by On-Site Sewage Disposal Systems", October 1982

7. Province of Nova Scotia, Department of Health, "Policy - On-Site Sewage Disposal for Buildings Containing Multiple Dwelling Units", April 1977

8. Boesma L., "Field Measurement of Conductivity Above a Water Table", Methods of Soil Analysis Part 1, No.9 in Series on Agronomy, American Society of Agronomy Inc., Madison, Wisconsin, 1965 Pg.222

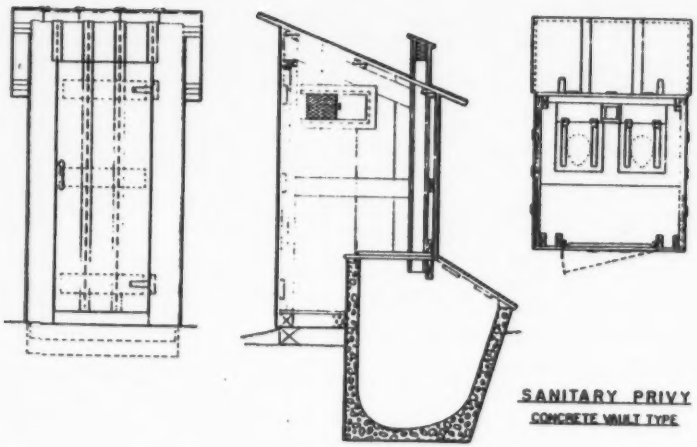
9. Otis R.J., "Pressure Distribution Design for Septic Tank Systems", Journal of Environmental Engineering, ASCE, Vol.108, No.EE1,Proc.Paper 16866, February 1982, Pg.123, ISSN 0090-3914/82

10. Pask D.A., "A Contour Drain Disposal Field for Septic Tank Effluent in Low Permeability Soils", M.Eng Project Report, Technical University of Nova Scotia, 1983

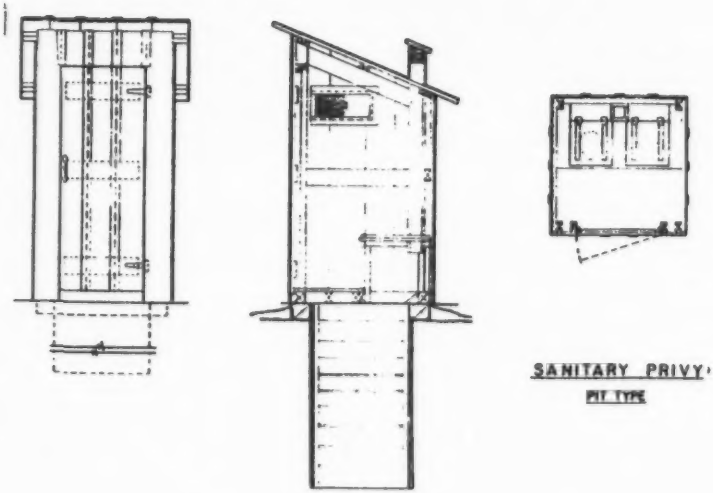
11. Pask D.A., Casey P.J., Vaughan J.G.,Thirumurthi D., "Recent Research and Developments in On-Site Sewage Disposal in Nova Scotia", Proceedings of the Fourth National Symposium on Individual and Small Community Sewage Systems,A.S.A.E., St.Joseph, Michigan.1984

12. Terzaghi K.,Peck R.B.,"Soil Mechanics in Engineering Practice",John Wiley and Sons Inc. New York, 1967

APPENDIX B



SANITARY PRIVY
CONCRETE VAULT TYPE



SANITARY PRIVY
PIT TYPE

APPENDIX C

Simplified Falling-Head Permeameter Test for Fill Material for Disposal Fields.

The permeameter consists of a plexiglass clear plastic tube with one end covered by a fine mesh screen. The cylinder is stood in a low plastic container with a layer of filter fabric at the bottom to allow free exit of permeating water. The details and general arrangement of the apparatus are shown in diagram C 1.

Approximately 60 mm. of the sand to be tested are filled into the cleaned cylinder and compacted by allowing the cylinder to fall 200 mm. five times onto the workbench. More sand is added to the 110 mm. mark and again compacted. The cylinder is then placed in the container and the sand flooded from the bottom up to drive out any air. After allowing the wet sand to drain excess water, the sample is again compacted by dropping five times and the sample is trimmed to a finished height of 100 mm.using a suitable scraper.

The cylinder is now returned to the container, flooded from the bottom up and then water is carefully poured into the top of the cylinder above the upper reference mark. The water level is now allowed to fall, noting the time in minutes that it takes to pass over the 50 mm. gauge length. Measure or judge the temperature of the water used in the test. Now refer to the chart in figure C 2 to determine the apparent permeability.

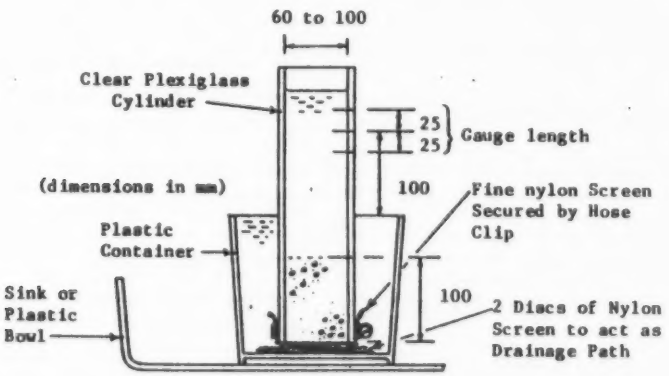


FIG. C1 Falling Head Permeameter - Apparatus

Derivation

$v = ki$ (Darcy)

Where k = Permeability (m/s)
v = Velocity (m/s)
i = Hydraulic gradient (-)

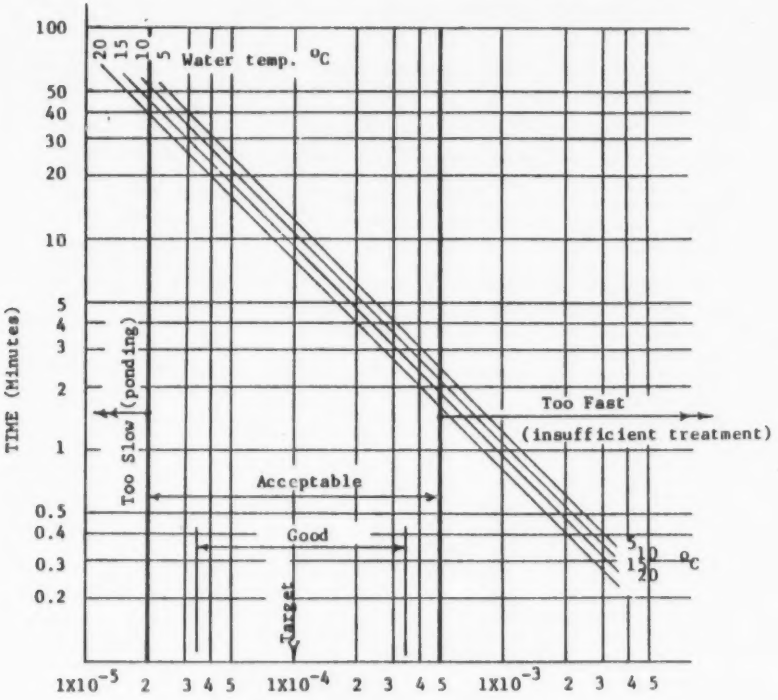


FIG. C2 Falling Head Permeameter
Pemeability Chart

APPENDIX D

DEEP DRAUGHT SIPHON

The siphon shown in the diagrams on page D-03 was developed as an alternative to commercial siphons for use in septic tank disposal fields. The siphon is constructed of standard plastic (PVC or ABS) pipe and fittings with solvent welded joints and is suitable for use in a standard pre-cast concrete septic tank as a siphon chamber. The deep draught (the design has been tested at approximately 5 feet) permits the use of a more economical configuration of tank for a given discharge volume.

The two unusual aspects of the design are important. The siphon break delay tank shown at B on the sectional elevation ensures that the upper limbs of the siphon are completely vented when the siphon breaks. Without the tank and orifice disc, the siphon will break by formation of a vortex at A. On cessation of flow the vortex disappears and the low water level settles above the inlet to the siphon leaving a partial vacuum in the upper siphon at CD. On refilling the chamber the partial vacuum lifts the water over the top bend when the general water level is still below CD and the height of water in leg DE is too high for any bubbles of air to be carried to the discharge. Hence, except at very high flows, the siphon passes the inflow to the discharge without priming and the tank does not empty.

With the delay tank and orifice, as the siphon discharges, some water is retained in the horizontal pipe and the orifice does not clear until the general water level is below B, thus ensuring that air can bubble in until the whole of the upper legs are drained down to the general level.

The second feature is the sloping leg DE which assists in priming the siphon at top water level. Water will begin to flow over the top bend D of the siphon when the head P in the tank is approximately equal to the head in leg FG (Q). Streaming down the low side of the pipe, the flow causes rotary motion in the leg EF, creating a form of horizontal vortex, enabling air from leg DE to be held in suspension and vented to the overflow pipe GH. At the same time the weight of water in leg FG becomes less, because of the entrained air, lowering the pressure at E, which enables a greater flow to pass under head P and the siphon quickly primes.

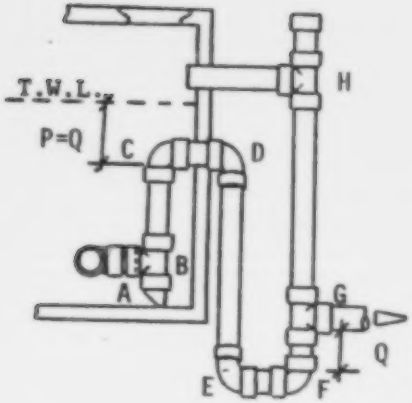
A prototype siphon of 4in.dia. pipe primed at a flow of 2 gallons per minute. The siphon performs equally well with leg ABC vertical or sloping, as tests showed that the volume of trapped air is not critical.The sloping version should be used in circular tanks but does require to be anchored down to prevent flotation. The siphon has been constructed in pipe sizes from 1.25 to 4.0 inches diameter.

The design may be adapted to almost any shape and configuration of siphon chamber but certain dimensions are critical. The inlet and overflow may be at the same level but must be at least three inches above the selected top water level. The bottom water level will be from three to five inches above the floor of the chamber. The discharge pipe invert should be at least six inches below the floor level of the chamber. The invert of the top bend of the siphon (marked "CD" on the sectional elevation) ,which passes through the wall of the chamber,should be set at least six inches below the top water level but may be set lower. The bottom bend (marked "EF") should be set with its soffit exactly the same distance below the invert of the outlet pipe as the invert of the upper bend is below the top water level.

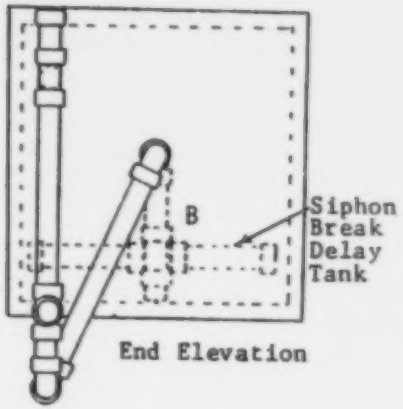
The diameter of the pipework does not appear to be critical but it is suggested that 4 in. diameter would be appropriate for chambers larger than 1000 gallons discharge, 3 in. for 200 gallons or more and 2.5 or 2 in. diameter for less than 200 gallons. The siphon break delay tank or cross pipe should be of the same diameter as the main pipework, but the length has not been found to be critical. From 1.5 to 3.5 feet has been found satisfactory. The orifice diaphragm placed between the crossed tee's should be securely cemented or sealed in place. It may be cut from flat plastic sheet approximately 1/8 in.thick and drilled with a 1/4 in.dia. hole in the centre.

Before putting the siphon chamber in service the bottom bend ("EF") should be filled with water via the vertical inspection pipe, otherwise the siphon will trickle continuously without priming. The siphon may then be tested by filling the chamber,reducing the rate of inflow to perhaps two gallons per minute as the water level rises to the expected discharge height. The test should be run at least twice to prove satisfactory operation.

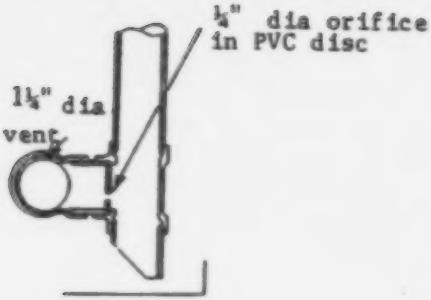
Maintainance requirements are simple. The chamber should be pumped to remove accumulated sediment whenever the septic tank is cleaned. At the same time the delay tank or cross pipe should be flushed out with a garden hose through the vent hole. Should it become evident that the chamber is trickling continuously at a high water level it is probable that the delay tank orifice has become blocked. To lower the water level for clearing this force the siphon to prime by either increasing the inflow to a high rate or temporarily raise the level by blocking the outflow through the vertical access pipe,and then release it.



Sectional Elevation



End Elevation



Detail at B

Siphon in PVC Pipe and Fittings

APPENDIX E

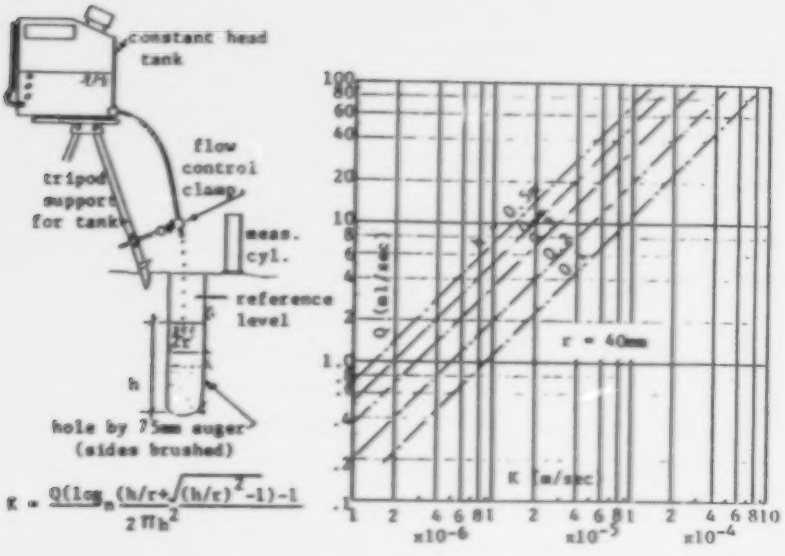
Measurement of Permeability of Soils In-Situ

J.Bouma describes a method of measuring the permeability of soils in the field known as " The shallow well pump-in test"(ref.8).The method requires a rather complex apparatus to maintain a constant level of water in a test auger hole.A modification of this test has been developed in which a constant flow of water is fed into a narrow auger hole into the desired soil horizon, allowed to achieve stability, and the resultant water level is measured.The results are applied to the formula developed by Bouma to give a reasonable approximation of the permeability in that soil horizon.

As used in the Department of Health, the proceedure is as follows :- A hole is bored in the soil to a depth of approximately 600 mm. using an "Engle" soil auger of 75 mm.diameter. The hole is then cleared of any smearing using an extended handle wire brush, carefully removing any debris. The hole is carefully measured and a reference mark (toothpick) is fixed in a convenient position for subsequent measurement of water levels. A quantity of clean course sand is then poured in to a depth of 250 mm. to support the sides and prevent scour at the bottom of the hole.

A container holding approximately 20 litres of water and fitted with a delivery pipe and flow control valve is then placed above the hole on a tripod or other suitable stand. If the container is rigid it can be converted to a constant head apparatus (see diagram) otherwise frequent manual adjustment of the flow rate may be required. After an initial high rate, the flow is adjusted over a suitable period until a constant water level is maintained in the hole approximately 200 to 300 mm below ground level, for perhaps one hour. The flow rate is then measured by means of a graduated cylinder and stop-watch.

Calculation of permeability is facilitated by use of the chart in the diagram below.

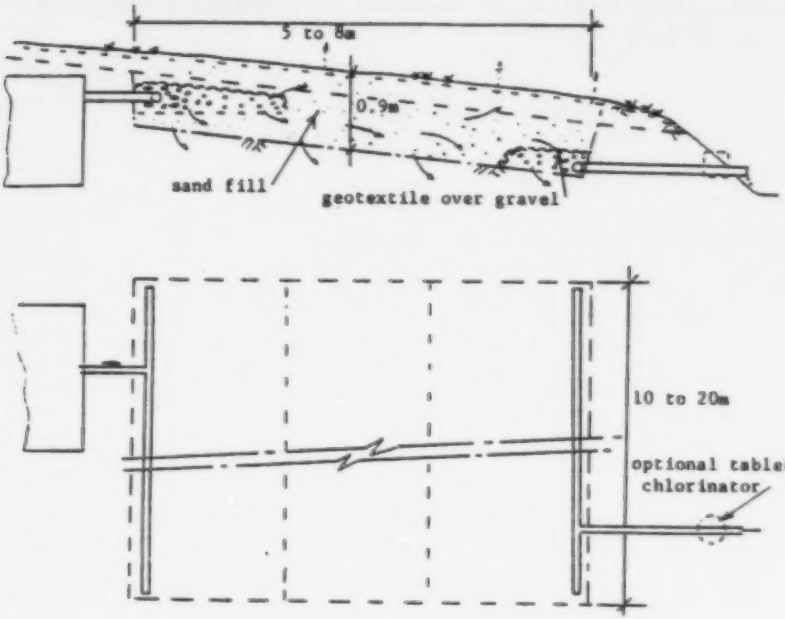


Modified "Shallow Well Pump-in Test" for Permeability

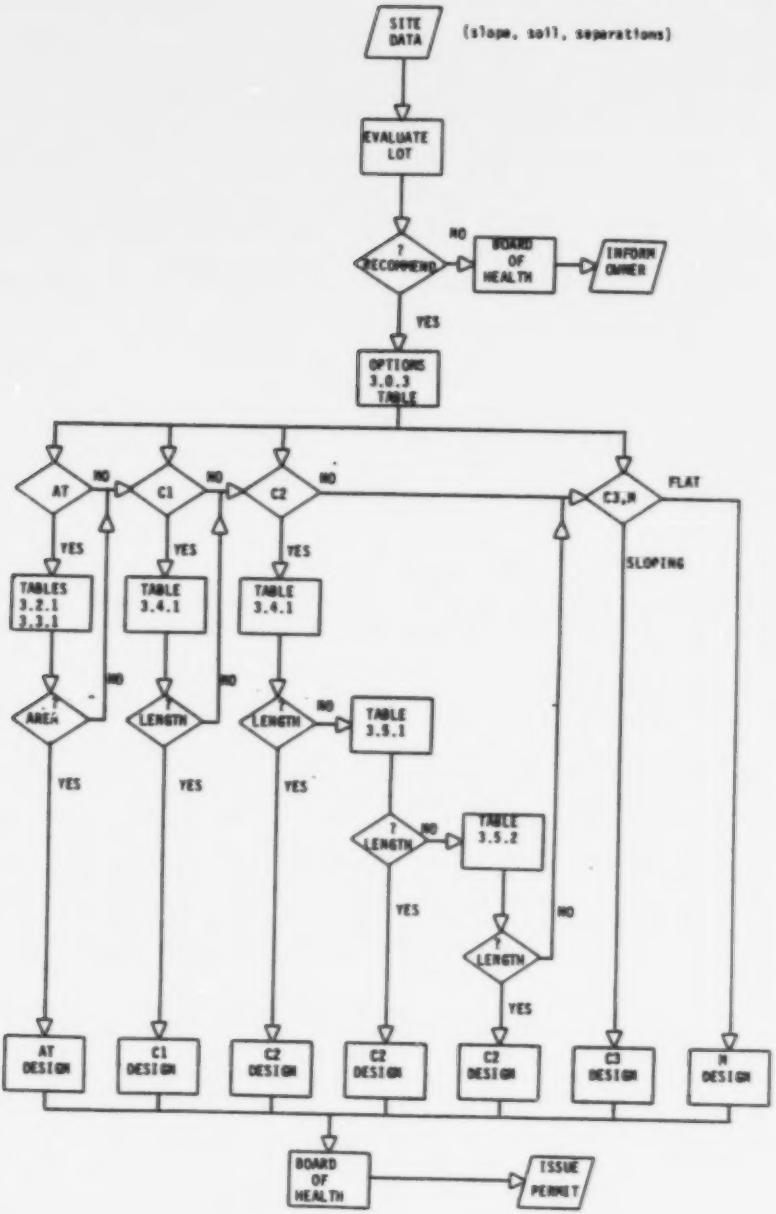
APPENDIX F

Sloping sand filter

This underdrained sand filter is intended for use only for the renovation or replacement of failed disposal fields in low permeability soils. In favourable seasons the discharge to ditch or watercourse is negligable or absent due to the large exfiltration and transpiration area. The low overall head loss can eliminate pumping.



Lateral Flow Underdrained Sand Filter



FLOW CHART FOR SELECTION OF APPROPRIATE DISPOSAL FIELD

APPENDIX H

Guidelines for recommendation of minor variation in technical requirements of the On-Site Sewage Disposal Regulations.

These guidelines are for the use of qualified persons, as defined in the Regulations Respecting On-Site Sewage Disposal Systems, employed by the Nova Scotia Department of Health. All Public Health Engineers and Public Health Inspectors are required to comply with them. The sections of the Regulations in which variation from the requirements as stated are allowed are defined. It must be clearly understood that variations are to be recommended only in circumstances which, in your professional opinion, will not now or in the future result in pollution or contamination of surface water, ground water or the ground surface. Certain sections of the regulations have been excluded from discretionary review because any deviation from the values, requirements or specifications contained in these sections would impose restrictions on neighbouring properties or tend to cause an increased health hazard, e.g. distance from foundation drain.

Administrative proceedures for recommending and recording variations are also outlined.

Administration

1. The Public Health Inspector will submit a report to the Supervisor on any lot which may be considered suitable for a minor variation recommendation under the regulations. The report should contain a detailed description of the situation and give reasons justifying the minor variation from the technical requirements of the regulations.

2. Such report will be reviewed by the supervisor and/or public health engineer for the area in consultation with the public health inspector. A recommendation for a minor variation shall be made only with the concurrence of two or more of the departmental qualified persons involved in evaluating the report. In all cases, the responsible qualified persons in the area should be informed of the decision (usually the supervisor or engineer not initially consulted). It is expected that the inspector supervisor and engineer will all concur in most recommendations unless they are very minor or circumstances do not permit full consideration.

3. A recommendation by a qualified person for a minor variation shall be made to the Board of Health on a special form devised for that purpose. A copy of the recommendation shall be attached to the application and permit wherever a minor variation from the regulations is recommende by a qualified person and or allowed by the Board of Health.

4. A separate record of each minor variation recommendation made shall be maintained in each Health Unit office and a copy forwarded to the Chief Public Health Inspector. Periodic review of these records shall be made by the Division of Public Health Engineering to determine any need for a change of policy.

5. If the distance from a dug well or drilled well is to be recommended as less than 100 ft. or 50 ft. respectively, the Department of the Environment, Water Resources Planning Division, is to be consulted. (Tel.424 5300 ext.190)

Requirements of the Regulations appropriate for minor variation.

Regulation	Subject	Vary ?	Comment
CATEGORY I LOTS			
8(2)(a)	Natural permeable soil over 2ft.	No	Any less soil depth to be rated category II
8(2)(b)	Min.20000 s.f.X 100 ft. Min.10000 s.f.X 75 ft. (central water)	Yes Yes	
8(2)(c)	Min.40000 s.f.X 150 ft. (waterfront)	Yes	
CATEGORY II LOTS			
8(3)(a)	Natural permeable soil 1 to 2 ft.	No	Any less soil depth to be rated category III
8(3)(b)	Min.50000 s.f.X 175 ft.	Yes	
CATEGORY III LOTS			
8(4)(b)	Min.100000 s.f.X 250 ft.	Yes	
CLEARANCES			
Particular note is to be made of Regulation 15(3) which states, in effect, that clearances may not be reduced when either the lot area or the lot width is also reduced.			
9(1)	Well casing length	No	
9(2)(a)	Boundary clearances	Yes	Only in exceptional circumstances
9(2)(b)	Well clearances	Yes	In consultation with Dept.of Environment

Regulation	Subject	Vary ?	Comment
9(2)(c)	Watercourse clearance	Yes	In consultation with Dept. of Environment
9(3)	Septic tank/well separation	Yes	Only where contamination unlikely and in consultation with Department of Environment.
9(4)	Vertical separation	Yes	Minor variation not required if written on permit
12(c)	Adjacent to sanitary sewer	Yes	Only if connection to sewer would require pumping of raw sewage.
28(2)(b,c,d)	Lots subdivided before 19 Jun 75	Yes	

APPENDIX I

Nova Scotia Department of Health - Health Unit Offices

Atlantic Health Unit

		Telephone
Head Office E,PHI	1600 Bedford Highway, Bedford, N.S. B4A 1E8	835 7181
Sub Offices PHI	6061 Young Street, Halifax, N.S. B3K 2A3	424 3959
PHI	Captain William Spry Community Centre 10 Kidston Road, Spryfield, N.S. B3B 2J2	479 1111
PHI	277 Pleasant Street, Dartmouth, N.S. B2Y 3S2	424 5370
PHI	P.O.Box 27, Musquodoboit Harbour, N.S. B0J 1L0	889 2075
	(Sheet Harbour	885 2462)

Cape Breton Island Health Unit

Head Office E,PHI	Provincial Building, Sydney, N.S. B1P 5L1	564 4447
Sub Offices PHI	7 Fraser Avenue, Sydney Mines, N.S. B1V 2B8	736 6245
PHI	P.O.Box 6, Baddek, N.S. B0E 2B0	295 2159
PHI	P.O.Box 57, Port Hawkesbury, N.S. B0E 2B0	625 1693
PHI	Professional Centre, 65 Minto Street, Glace Bay, N.S. B1A 5B5	849 4567
PHI	P.O.Box 133, St. Peter's, Richmond County, N.S. B0E 3B0	535 2026

Cobequid Health Unit

Head Office E,PHI	P.O.Box 40, Truro, N.S. B2N 5B6	895 5321
Sub Office PHI	P.O.Box 332, Amherst, N.S. B4H 3Z5	667 3319

Fundy Health Unit

Head Office PHI	100 King Street, Windsor, N.S. B0N 2T0	798 2264
Sub Offices PHI	P.O.Box 104, Shubenacadie, N.S. B0N 2H0	758 2097
PHI	P.O.Box 203, Bridgetown, N.S. B0S 1C0 (Annapolis Royal)	665 4511 (532 2381, L.58)
E,PHI	Provincial Building, 120 Exhibition Street, Kentville N.S. B3N 1C3	678 8931

Lunenburg-Queens Health Unit

Head Office E,PHI	99 High Street, Bridgewater, N.S. B4V 1V8	543 4685
Sub Offices PHI	P.O.Box 67, Chester, N.S. B0J 1J0	275 3581
PHI	P.O.Box 694, Liverpool, N.S. B0T 1K0	354 5737

Northumberland Health Unit

Head Office PHI	Aberdeen Mall, New Glasgow, N.S. B2H 5E5	752 5151
Sub Offices E,PHI	11 James Street, Antigonish, N.S. B2G 1R6	863 2743
PHI	P.O.Box 310, Pictou, N.S. B0K 1H0	485 4388

Western Health Unit

Head Office PHI	P.O.Box 338, Yarmouth, N.S. B5A 4B3	742 7141
Sub Offices PHI	P.O.Box 481, Digby, N.S. B0V 1A0	245 2557
PHI	P.O.Box 125, Shelburne, N.S. B0T 1W0	875 2623

Key PHI - Public Health Inspector
E Public Health Engineer